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RESPONSIBILITIES AND SECURITIES.

Certainly the country is in a new state of relationship between public service corporations and the communities they serve. We have just gone through an era of ill feeling, whose angry echoes still ring in weary ears; but it is not too much to hope that we are approaching an era of good feeling, and of friendly understanding. To this end the new Public Service Commissions can do a great deal; and they were created for that purpose quite as much as for any other. Meantime the corporations can do much themselves by taking the public into their confidence and explaining matters patiently and carefully. A tactful example of how to do this is presented in some recent advertising of the New York Telephone Company, which last week in one particular piece of publicity outlined a "code of ethics" for any public service system in its attitude toward the public served. It was entitled "Our Responsibilities to the Public," and was altogether the kind of sober appeal that any intelligent man will assent to and give the support of his active approval.

No company can thus put down plainly in detail its public responsibilities without setting up a measure of conduct and trying to live up to it. In so doing it makes a long step toward winning the public support, which is worth more than its franchise; without which the franchise is a mere bit of paper. We hear a lot about "underlying securities" when a company's bonds are discussed, but there is no better underlying security in the world than public good-will earned by good service.

DAY CIRCUITS IN SMALL TOWNS.

The establishment of day service by a central-station company in a small town of from 2000 to 5000 inhabitants is likely to be accompanied with many fears and misgivings on the part of the conservative owners of the property. The discussion on this subject at the recent Illinois State convention was of a very practical character, and is given considerable space elsewhere in this issue because of the suggestions contained and the experiences cited from a number of small towns where successful day service has been established. It is seldom that a company in such a town can start a day service with the reasonable expectation of having it pay the first six months. In some towns day service has been started in such a half-hearted manner that it was doomed to failure from the beginning. If there is sufficient power business in sight to give an income in excess of the fuel and labor involved in giving day service, there should be no question about the advisability of starting such service, but there should be no expectation of making it pay from the start. The length of time within which it can be made to pay will depend largely on the energy and enthusiasm of the manager and the reliability of the service given. Day load will come only after the fact that reliable day service has come to stay is well established in the com-

munity. Furthermore, it takes some time to displace steam and gasoline engines with motors; but once a day service is established, the most vigorous effort should be made to put it on a paying basis. The quickest way to do this is to put out apparatus on trial. This can be done, even in the case of motors of considerable size. The success reported at the Illinois convention by a number of members is most gratifying.

Star and Delta Transformer Connections.

On a single-phase alternating-current system there is a certain convenience in the simplicity of transformer connections. It is "Hobson's choice." The primary winding of any one single-phase transformer is connected to the primary mains, and the secondary winding to the secondary mains. The only precautions that have to be taken are that the transformers used are all alike in voltage, and that when transformers are connected in parallel, so as to share a load, the secondaries must be coupled in the right direction, otherwise they will short-circuit each other. But on a three-phase system there is a considerable latitude of selection between methods of connecting transformers. There are the delta-delta, the star-star, the delta-star and the star-delta methods of connection, besides a few subvarieties. In the delta-delta type the three primary windings are connected in delta, and the three secondaries also in delta, care being taken to make no short-circuit at the last link. In the delta-star type the three primaries are connected in delta, but the three secondaries are in star, and so on for the other types. Mr. W. T. Ryan, in the article we publish this week, discusses the pros and cons of the various types of interconnection, taking into consideration the accidental disturbances that may arise in a three-phase system. The conclusion at which he arrives is that the delta-delta arrangement is ordinarily the best. In this opinion we concur, if the three-phase system is a distributing system of, say, less than 20,000 volts e.m.f. In such a system the advantages of the delta-delta connection of transformers are, first, that each transformer is of the ordinary single-phase type, with its voltages respectively the same as those of the primary and secondary mains, so that no special types of transformer are required; second, if any one of a bank of three transformers breaks down and is cut off by fuses, the other two can continue to carry, in open delta, the rated load of the bank with a heavy power overload. Third, if one of the three high-tension mains becomes accidentally grounded, the other two will be raised considerably in potential with respect to ground, but not to a dangerous degree. In such a case the danger to breakdown of insulation commonly occurs in the generator rather than in the line or in the transformers; but up to 20,000 volts e.m.f. this danger can usually be safeguarded.

When, however, the three-phase system under consideration is a high-tension transmission system, and which, therefore, is likely to contain only a limited number of transformers, the question of the best method of connection is not so easy to settle, and much depends upon the local conditions. A favorite method is the delta-star at the generator or step-up end, and the star-delta at the receiving or step-down end of the line. A marked advantage of this system is the reduction of static stress upon the high-tension windings owing to the use of the neutral point in the high-tension system. This neutral point can be kept at or near zero potential under every condition. As for the prevailing tendency to ground all parts of a high-tension system not immediately connected to high potential, there is much to be said on both sides of this question, but so far as concerns safety to persons in the generator- and sub-stations, it cannot be denied that the highest degree of security can only be obtained by permanently grounding everything that may properly be grounded.

With the simple delta-delta connections advocated in the article there is least likelihood of producing accidental short-circuits in a distributing system. Thus, as is well known from sad experience, a delta-delta bank of transformers will not operate in parallel with a delta-star bank on the same system of mains. A partial short-circuit follows such a connection. But delta-delta banks are always capable of operating satisfactorily in parallel on the same mains. It is not generally recognized that three-phase unit transformers—that is, single transformers with three-phase magnetic cores, fluxes and windings—are superior to equivalent banks of three single-phase transformers, and still more to equivalent pairs of open-delta transformers, in first cost and efficiency. In case of accidental breakdown, say, by lightning, there may be more chance of the bank of three single-phase transformers maintaining service than the three-phase unit; but such breakdowns are comparatively rare, nor need they be of long duration.

The Parallel Operation of Direct-Connected Alternators.

It is a necessary condition of all elastically-connected machinery that individual parts may throb and pulsate to a certain extent. Alternating-current generators and motors are no exception to the rule. Any synchronous motor running on an alternating-current circuit, single-phase or multiphase, oscillates more or less in its speed above and below the normal uniform frequency-speed. Ordinarily, these oscillations are so small as not to be noticeable even under careful observation. Under occasional combinations of circumstances, however, the oscillations in speed, or pulsations, may be so marked as to be evident to the senses, or to show on switchboard ammeters. Such marked pulsation is called "hunting." Pulsations which are not sufficiently marked to be noticed as hunting may, at times, be rendered evident, either by stroboscopic observation of the rotor in the alternating-current machine or by watching the electric-current wave-form in the oscillograph.

When the alternators in a power system are turbine-driven their pulsations are ordinarily very small, and may be occasioned by slight fluctuations or disturbances in the load on the system. Any sudden increase or decrease of load produces a swing in the rotors that, unless they are actually damped to the dead-beat point—a rare condition—produces a train of diminishing pulsations, whose period is determined by the electrical and mechanical conditions of the system. If, however, the alternators are driven by reciprocating engines, the power applied to them pulsates with the frequency of the engine cycle, so that there is produced a constant succession of pulsations, as described in the article by Mr. A. E. Buchenberg on page 1224 of this number. With the usual amount of damping in the machines, the pulsations of reciprocating engines are not likely to become cumulative and produce dangerous hunting, unless the natural period of the alternator oscillations happens to coincide with the period of pulsation in the engine cycle. In such cases, violent hunting may be produced.

ELECTRIC LIGHTING IN GERMANY.

A recent supplement to the *Elektrotechnische Zeitschrift* gives in connection with the text of an Imperial tax measure, some most interesting details of the state of the lighting industry in Germany and of its progress in recent years. The figures given leave no doubt of the activity in German electrical works. Ten years ago, in 1897, there were in the Empire 265 electricity works carrying a combined load of 83,000 kw. In 1907 there were 1530 stations carrying 1,100,000 kw. Even more striking than the increase of plants is this more than tenfold increase of load. Almost half of the total is due to motor load which, especially in the last two or three years, has increased with great rapidity. In particular from 1905 on both lighting and power, loads jumped suddenly to a rate hitherto unknown, a fact especially interesting on account of the coincidence of this period with the increasing use of the metallic-filament lamp. Anyone who takes a gloomy view of the effect of these lamps on station output may well stop to contemplate the fact that in the period 1903-1905 the lighting load of the German stations increased about 77,000 kw, while in 1905-1907, the first years of activity of metallic-filament lamps, it rose 200,000 kw. It is at least safe to say that the modern incandescents have not had a disastrous effect on station output. Some casual figures are given also on the output of gas works during a parallel decade, 1896-1906, and while the figures are not complete, they show that the output within that period has a little more than doubled as compared with a tenfold increase in electrical energy.

It should be, of course, remembered that this huge difference cannot be charged entirely to competitive values, since the gas companies were first in the field and had passed their period of natural rapid growth prior to the decade considered. During that decade their increase was more nearly that due to natural growth of the cities than to improvements in the art and increase of new opportunities. Gas has apparently been worked up to the point where the per capita consumption increases rather slowly, while electricity is constantly finding wider fields of usefulness and its per capita consumption is still capable of very large increases. With this increase comes naturally reductions in price to an extent that gas plants cannot now follow, and hence the use of electricity increases at a very disproportionate rate. The very rapid development of motor service in the German stations is evidence of great activity in exploitation, aided by very low prices for motors. A German motor price list from one of the first-class makers is a startling revelation. The labor cost in Germany for the construction of such machines is about half what it is here, which difference counts tremendously, especially in the case of small motors. As regards gas and electric lighting, some interesting data upon efficiency are given showing that with the best incandescent lamps of each class, one kw-hour and one cubic meter of gas are nearly equivalent in the matter of light given, while the extreme intensive types of arc, like the flame lamp and the quartz mercury lamp, give two or three times as much light as either of them for the same energy. In heating and cooling, so far as illuminating gas is concerned, one cubic meter equals approximately one kw-hour, so that the same general ratio is preserved. About the same ratio of values is also stated to hold for gas-engine practice with ordinary illuminating gas. It is sufficiently apparent, therefore, that the vast increase in the consumption of electrical energy has not been on the basis of cheapness, but upon that of practical value for human use. On the whole, electrical energy is quite as dear in Germany as here, and gas quite as cheap, so that the increase of electrical consumption speaks for itself. There has been much fruitless argument as between electricity and gas based on the rather stupid fallacy that of two articles adaptable to the same use one should always take the cheaper. To make good their bluff some of our gas-exploiting friends should dress in burlap and live on hog and hominy every day in the year. People, in fact, buy things that suit them regardless of their being positively the cheapest things in the shop, and so in spite of the low cost of gas lights, humanity still perversely turns to electricity, as the figures before us bear witness. In taking up these matters of cost, we note that the tungsten lamp is credited with a life of about 1000 hours and the retail price is stated to be 2 to 3 marks. The price of energy for operating them, of course, varies widely. In general terms, the common base-price for lighting in German stations runs somewhere from 10 to 12½ cents per kw-hour. Discounts are, as a rule, less generous than in our country, and returns made a couple of years ago from 139 German stations, big and little, showed receipts from lighting to average just about an even 10 cents per kw-hour. Since then there have been reductions of price in some of the stations concerned, but, on the whole, German stations get fairly good prices, which makes the growth of the business even more striking. The figures for power in the list mentioned average a shade less than 4½ cents per kw-hour, a price considerably above the theoretically equivalent price for gas-power, in spite of which the motor load had risen nearly a quarter of a million kilowatts in the last two years. Evidently it takes something beyond the quality of cheapness to get business.

A very interesting feature in the statistics of the German stations is the activity with which water-power has been utilized. Good steam coal is not cheap in Germany and hydraulic power is consequently in demand, although relatively scarce. From the reports cited, the total water-power available in the Empire is a scant 2,000,000 hp, of which nearly half is in Bavaria. One-quarter of this is already utilized for various purposes, of which the electrical industry seems to get its share; for up to last year there were 562 stations operated wholly or in part by water-power, Bavaria, as might be expected, showing the largest utilization. An instructive feature of the statistical reckoning is the considerable number of stations (86) using a combination of water and gas or other explosion engines. These plants were mostly small, like the 210 plants shown to be operated by explosion engines alone. Monetary statistics are rather difficult to figure as averages in the German stations owing to the large number of municipal plants in which the costs, as they would appear in American bookkeeping, are rather hard to disentangle. In some cases the costs are very carefully kept, but there is commonly a scattering of items among different departments that leaves some doubt as to the final result. Of privately-operated supply stations, a group of 57 during the years 1906-1907 paid an average dividend of 5.1 per cent, certainly not a bad showing considering the very large amount of underground work in Germany, implying a heavy capital charge. Altogether, the German lighting industry seems to be in a rather good condition and with every improvement in lamps it seems to improve.

Movement to Encourage the Central Station Industry in the Northwest.

Harry L. Bleecker, secretary of the Washington Water Power Company, of Spokane, and chairman of the executive committee of the Northwest Electric Light & Power Association, has called a special meeting of the last-named organization for Dec. 18, at Portland, to discuss a plan to familiarize Eastern investors with the opportunities in the smaller towns in the Northwest, especially in places where electric power may be distributed for irrigation purposes. The larger cities have been provided for. The committee will also take up the question of establishing a uniform rate for electric lighting companies in these towns, where some concerns are running at a loss, while others are making overcharges.

A publicity company is planned under the supervision of the association for the development of the entire Northwest, the territory embraced including Washington, Idaho, northern Oregon and western Montana. Important improvements and necessary extensions for the smaller towns of this territory have been handicapped by lack of capital, and the failure heretofore to convince Eastern capital of the marvelous possibilities and fields for investment in electrical securities. Eastern capital is shy of these securities in towns of 4000 and 5000, comparing Western cities with those of the same size in the East, which, instead of increasing, show less population, sometimes, at the end of 10 years, while the reverse is true of Western cities, which forge ahead with tremendous strides.

A Dinner Given by Telegraphers to Carnegie.

A dinner of unusual character and significance was given on Nov. 27 at the Hotel Manhattan, New York City, when veteran telegraphers to the number of 73 united in a banquet to Mr. Andrew Carnegie to celebrate his seventy-third birthday and extend to him their "73." This was certainly a happy way of ringing the changes on the well-known telegraphic greeting of good wishes and good fellowship, and the affair was engineered by the U. S. Military Telegraph Corps, which Mr. Carnegie on behalf of the government organized at Washington in April, 1861, for the Civil War, with a nucleus of operators from the Pennsylvania Railroad. Since the war ended, persistent efforts have been made to give the survivors of the corps, once mustering nearly 1500 men, the official rank and status to which they are entitled and that would carry with it right to a pension. President Cleveland signed the law conferring rank, but in the absence of a pension Mr. Carnegie has himself placed the worthy and needy members of the gallant corps he founded on a pension list of his own, each man getting the regular $12 per month allowed by the government. Some 60 or more veterans enjoy this generosity, but not even their benefactor knows their names. There are between 300 and 400 of the corps still surviving.

All these facts were made known during the banquet at which Colonel Clowry, head of the Western Union system, presided with suave dignity. Over his head, in incandescent lamps, was the signal "73," and around him all told were about 125 men, nearly all telegraphers of long standing and many of them prominent members of the corps. The dinner was admirably organized, thanks to the work of an efficient committee headed by Mr. D. H. Bates, who told recently in a very successful book the story of the telegraph at the White House in Lincoln's time. The speakers of the evening were Messrs. W. R. Plum, W. B. Wilson, D. H. Bates, R. O'Brien, W. J. Dealy, C. P. Bruch, and A. B. Chandler, all of whom had something pithy and eloquent to say. Mr. Carnegie made a charming acknowledgment of the honor paid him, and said he would rather have this testimony of good will and esteem from the men who had known him since his youth than any other credential in the whole world. It was not "official," but had the touching note of sincerity and friendship.

Among the participants was Mr. T. A. Edison, to whom Mr. Carnegie paid a high compliment as one of the real old-timers and as a great inventor who stood in a class all by himself. Another interesting feature was the beautiful singing of Miss Leila Livingston Morse, granddaughter of S. F. B. Morse, who was most enthusiastically received. The souvenir of the occasion was an exquisite little Bunnell sounder, of perfect construction, five ohms resistance, and fully wired for work. It bore a base plate telling the circumstances of the banquet, and was freely used during the evening by many an "old hand" to convey greetings across the hall.

Tungsten Patent Fraud Case.

Ned W. Barton, former assistant examiner in the United States Patent Office, who was indicted at Washington for conspiracy and forgery in connection with the granting to John A. Heany, of York, Pa., of a patent for the manufacture of tungsten lamp filaments, entered a plea of guilty on Nov. 30 and was sentenced to serve three years in the penitentiary.

Barton pleaded guilty to four indictments which charged him with conspiracy, forgery and the substitution in patent applications of specifications belonging to other inventors made later than that of Heany. The district attorney said that Barton's act was voluntary and that no immunity of any kind was promised to him. Barton was discharged from the Patent Office at the time of his indictment, and has since worked in York, Pa., and in Philadelphia. He is 29 years old and married. The cases against the patentee and patent attorney will go to immediate trial.

The Seasoning of Cross-Arms.

The U. S. Forest Service, Washington, D. C., has issued some data with regard to the seasoning and testing of cross-arms for poles used in electrical work. It appears that there are used every year in the United States about 14,000,000 cross-arms for telephone and telegraph poles. Of these, perhaps one-fourth are now treated with preservatives to increase their durability, and there are at least five plants, at New York City, Norfolk, Va., New Orleans and Slidell, La., and West Pascagoula, Miss., at which cross-arms are treated. Because of their small size as compared with the strength required and the weakening effect of the holes for insulator pins, and their constant exposure to all kinds of weather, cross-arms should receive a thorough treatment. A good treatment with creosote will at least treble their durability.

A large portion of the supply of cross-arms comes from the South; they are sawed from the loblolly or old field pine, of which there is a large quantity. It is necessary so to pile the cross-arms that the air may circulate freely about them, and to protect them from rain and snow by a roof of loose boards. By laying 20 cross-arms in a tier, two cross-arms at each side and two in the middle set on edge, and allowing a small space between each of the others, which are laid flat, favorable conditions for seasoning are established and no rotting will occur.

The cross-arms should be sorted in three classes, as sapwood, intermediate, and heartwood, and treated in different runs. Cross-arms are treated in large horizontal cylinders varying from 90 ft. to 180 ft. in length and from 6 ft. to 7 ft. in diameter. Into these the arms are run on skeleton trucks, and the doors are then bolted air-tight. Creosote is next run until the remaining space in the cylinder is filled. Pressure is sometimes then applied by pumps to force the preservative into the wood. In some instances before the preservative treatment the cross-arms are treated to a bath of living steam followed by the drawing of a vacuum, to remove moisture and secure rapid penetration of the wood by the preservative. It is the opinion of the Forest Service, however, that the bath in steam is not necessary or desirable if the arms are properly air seasoned. Other recommendations for seasoning and treating cross-arms, and a discussion of the methods now in use, are contained in Circular 151 of the Service, which can be had upon application.

Central Station Competition in Chicago.

The Cosmopolitan Electric Company, which has been operating in a small way on a franchise granted Feb. 25, 1895, has obtained from the city building department a permit to build a $280,000 power house at the intersection of Canal Street and the river. This company has, since the granting of the franchise, maintained a small electric-light plant at 2050 Grove Street. When the original franchise was granted to this company much talk was current that it would be a direct competitor of the Commonwealth Edison Company, but up to the present time no active opposition has been manifested. Mr. Roger C. Sullivan, secretary of the Cosmopolitan Electric Company, has announced that the company will now branch out and become an active competitor in the Chicago field. He also states that the Cosmopolitan company may become a competitor of the existing telegraph and telephone companies, which right is granted in the original franchise.

Denatured Alcohol in France.

In an interesting report, Consul-General Frank H. Mason, of Paris, gives a review of the present and prospective conditions in France relating to the manufacture and use of denatured alcohol. The production of denatured alcohol in France in 1907 was 593,836 barrels of 26.4 gal. The average wholesale price was 32 cents per gal., and the ordinary retail price is 47 cents per gal. The use of denatured alcohol for power purposes has not attained to any considerable importance in France, owing largely to the tendency of alcohol vapor when burned to corrode the interior of cylinders, and to the fact that alcohol, without a large admixture of benzol or gasoline, does not explode with sufficient rapidity to meet the requirements of automobile practice, and requires to be used in motors with valves and ignition apparatus specially adapted to that purpose.

At a competitive test of motor vehicles, held in May of this year, in which economy and tractive energy, rather than speed, were the principal elements of competition, a highly successful test was made by a group of nine motor cabs, built by several of the leading French automobile makers, and which used as fuel alcohol, carbureted with a 50 per cent admixture of benzol of the brand known in France as "Benzol Lepietre." This mixture cost, at the time of the competition, approximately 24.6 cents per gallon. The cabs ranged in weight from 3510 lb. to 3796 lb., and under strict official supervision a test run was made of 69.6 miles in 3 hours and 44 minutes, with a total consumption ranging from 6 liters, costing 38.6 cents, to 16 liters, costing $1.06, for the entire distance. This was a highly encouraging result and has had the effect of again directing attention to the subject of alcohol as a motor fuel, especially for industrial and commercial vehicles.

Indiana Electric Light Association.

At a meeting of the managers of central stations of Indiana, held at the Dennison Hotel, Indianapolis, Ind., on Tuesday, Nov. 24, an association was formed which is to be known as the Electric Light Association of Indiana. Twenty-four representatives of the leading central stations of Indiana were in attendance and letters were received from representatives of about 60 other central stations in which their support of the new association was assured. During the day the plans for the success of the association were talked over and the following officers were elected: President, Mr. T. C. McReynolds, manager of the Kokomo, Marion & Western Traction Company, Kokomo, Ind.; secretary-treasurer, Mr. Fred Leslie, superintendent, Muncie Electric Light Company, Muncie, Ind.

The next meeting will be held at Indianapolis on Tuesday, Jan. 26, 1909, when the organization will be perfected. An effort will be made before the meeting to interest every central-station manager in the state in the new association. Those in attendance at the last meeting are enthusiastic over the formation of the state association and each one present is pledged to give his support in making the new organization one of the strongest of the state associations.

Photometric Apparatus.

A meeting of the New York Electrical Society was held at the Electrical Testing Laboratories on Nov. 24 at which time Dr. Clayton H. Sharp described some recent developments in photometric methods and apparatus. Dr. Sharp explained in a simple and convincing manner the advantages which attend the use of the conception of light flux and light flux density in illuminating engineering problems. He outlined the older forms of integrating photometers, and described fully the recently introduced integrating sphere. The difficulties which were encountered in the practical design of integrating spheres for use with photometers were outlined, and the methods employed for overcoming the difficulties were discussed in detail. The integrating spherical photometer represents the best available device for ascertaining the mean spherical candle-power of the source of light. It embodies the acme of simplicity. When properly calibrated, the mean spherical candle-power of a lamp can be determined from a single observation.

At the conclusion of Dr. Sharp's address the members were afforded an opportunity to inspect the various departments of the Laboratories, where the older forms of photometric devices and the latest integrating photometric spheres were shown in actual operation. Among the many interesting types of testing devices which were exhibited may be mentioned the oscillograph used in connection with alternators, from which combinations of superposed sign waves of various frequencies could be obtained, and high-potential line insulator testing equipments, together with high-precision apparatus for standardization work.

Mr. W. S. Howell stated briefly the character of the work conducted by the Laboratories, special attention being directed to the growth of the undertaking. Equipment is now available for testing generators rated as high as 5000 kw and ammeters as high as 5000 amp.

The secretary read the names of 32 men who were elected to membership in the New York Electrical Society.

Vegetation as a Source of Fuel.

In his presidential address before the Ohio Society of Mechanical, Electrical and Steam Engineers, on Nov. 20, Mr. F. W. Ballard discussed in detail the rate at which the available coal is being wasted in this country. He called attention to the high fuel consumption of steam-engine generating stations, the low fuel consumption of gas-engine stations, the zero fuel consumption of hydro-electric stations, and pointed to the possibility of manufacturing alcohol from vegetation for use as fuel in internal combustion engines. He expressed the belief that alcohol is the proper logical vehicle for the transmission of the sun's energy from the plant to the engine.

Tests have shown that 0.8 pint of alcohol produces one brake hp-hour in an engine. A bushel of corn yields 2.5 gal. of alcohol, while a bushel of white potatoes yields 0.8 gal. The amount of corn raised in one year (1895) in the United States was 2,700,000,000 bushels, which would have been sufficient to produce 20,000,000 hp for 10 hours per day throughout the whole year; this power is equal to two-thirds of the total now used in this country. The amount of land available for agricultural purposes is at least 10 times that used for corn in the year 1895.

Mr. Ballard remarked that as the process of obtaining fuel from vegetation is developed commercially, the importance of manufacturing fertilizers by means of electricity becomes greater. Even at the present time the manufacture of nitric acid and nitrates from the air is past the experimental stage, about 4 lb. of 70 per cent nitric acid now being produced in Norway per hp-day of energy consumption. Calcium nitrate, now produced electrically at $20 per ton, is said to be better for fertilizing than sodium nitrate, which costs $48 per ton.

Fort Wayne Section of the Institute.

The Fort Wayne section of the American Institute of Electrical Engineers held a well attended meeting on Nov. 12. The meeting was preceded by the usual informal dinner, followed by the executive session. The paper for the evening, "Paralleling of Alternators," presented by Mr. J. J. Kline, of the Fort Wayne Electric Works, was followed by a very active discussion. Many interesting topics were brought up, Mr. A. L. Hadley speaking for some length on the cross currents which occur in alternators direct connected to slow-speed gas engines, and the difficulty of so adjusting the prime movers to reduce the cross currents to a minimum.

Mr. M. J. Kehoe described his experience with Westinghouse turbines direct connected to alternators, citing what had occurred in his plant on frequent occasions, when, without apparent cause, with two machines running in parallel, the machines would suddenly drop their load and the voltage would fall to zero. There seemed to all intents and purposes to be no cause for this on the part of the alternators, but it had occurred on numerous occasions and the makers failed to furnish a suitable explanation of the difficulty. It was suggested that the cross currents and armature reaction might succeed in demagnetizing the poles due to an excessive overload. Mr. Kehoe was asked to furnish further information on this point at the next meeting, although, as he explained, the trouble had been entirely obviated by the adoption of a Tirrill regulator. Owing to the lateness of the hour, the discussion was postponed until next meeting, when Mr. E. A. Barnes, superintendent of the Fort Wayne Works, will present a paper on "Choice of Power for Industrial Purposes."

Electric Car Lighting Without Emergency Service.

At the recent meeting in Chicago of the Association of Car Lighting Engineers a committee consisting of Messrs. C. W. Bender, T. R. Sloan and A. McGary presented a report on the subject of "Straight Electric Lighting"—that is, without provision of a gas or other emergency service for use in case the electrical service should be temporarily disabled. The report states that the question for discussion is whether, assuming a car to be electrically lighted, there is any necessity for the application of any auxiliary system of lighting other than candles for emergency use. The condition under which a car can be operated should be taken into consideration when determining what system of lighting—i. e., straight storage, axle generator, or head end system—should be used.

The straight storage system obviously can only be successfully used when the demand for current is well within the capacity of the battery, and there is ample time and charging facilities at layover points to permit recharging. If these conditions cannot be fulfilled this system of lighting should not be considered. With the head end and axle-generator systems, these limitations are removed, and the only question is the reliability of the generating and regulating apparatus.

In the opinion of the committee, the axle-generator and steam turbine have been developed to such a point that with competent inspection they will give satisfactory service. The weakest point in the former system is the regulating apparatus and drive, but with proper inspection at division points a belt may be tightened or replaced or regulator repaired, and the batteries, if in good condition, will easily carry a car over the division, which is as far as they would have to be relied on solely if the above inspection is made.

With the head end system the weakest point is the bursting of steam hose and failure of engine crew to furnish steam. In winter weather it is necessary to stop the train and replace the hose in order to avoid discomfort to passengers, and the possible freezing of the heating system. In summer weather, while the train does not ordinarily stop to replace a bursted hose, the batteries may be depended on to carry the load to the next division point. When the trouble is due to failure of engine crew to supply steam, a consistent hammering of the operating department will soon bring results.

The committee stated that it had knowledge of at least one road operating several hundred electrically lighted cars, these cars being equipped either for straight storage, axle-generator or head end system, and on which, with very few exceptions, there is no auxiliary system of lighting other than emergency candles, and the failures of electric lights are gratifyingly small. The majority of those that do occur are on account of insufficient layover time and inadequate charging facilities. It has also been noticed that, since the removal of the auxiliary system of lighting, the inspectors give much closer attention to the equipment, which has resulted in a decided decrease in lighting failures.

The conclusion of the committee is that if the proper system of electric lighting is installed to meet the demands of the service, any system of auxiliary lighting is not required and is only an unnecessary expense.

In discussion of this report a number of members endorsed the committee's recommendations. Mr. D. J. Cartwright, of the Lehigh Valley Railroad, said that his road had a number of cars depending entirely on electric lighting and candles, but that the candles so far had never been used. Mr. G. B. Colegrove, of the Illinois Central Railway, gave an example of the way train crews will economize where it is known that the batteries may become discharged and put the car in darkness if they do not save current. Mr. R. W. Massey, of the Frisco System, said that failures of gas on cars were as frequent as failures of electricity. Another member stated that the Pullman Company would not in general put out cars equipped only for electric lighting because of the uncertainty as to where they would be used, even though ordinarily employed on roads where the electric lighting would be maintained.

Mr. Cartwright, of the Lehigh Valley Railroad, in answer to a question as to the ownership of electrical equipment on sleeping cars on his road, said that from the car axle to the distributing board, the equipment was the property of the Lehigh Valley Railroad. From the distributing board to and including the lamps, it was the property of the Pullman Company. Mr. C. W. Bender called attention to the fact that failure of electric light in the statistics of some railroads does not mean that the lights actually went out, but that the voltage dropped a certain per cent below normal. Mr. Cartwright, of the Lehigh Valley, said that a 10 months' record, including 3856 car-days, showed nine cases in which the voltage fell below 28.5 on a 32-volt system, these being classed as failures. Mr. A. McGary, of the New York Central Railroad, reported that only once in 18 months was it necessary to light candles on any of the cars with straight electric lighting equipment on his road. Mr. C. W. Bender, of the Pennsylvania Railroad, reported that out of 8793 departures only six cars came in with lamps not operating.

Characteristics of American Central Stations.

With each succeeding issue of the McGraw Electrical Directory, devoted to the statistics and personnel of the central-station industry of the North American Continent, an attempt is made at improvement, so as to furnish some additional feature of information. The October issue for the current six months contains a good deal of new data. It embraces the statistics of no fewer than 5566 plants or systems, of which 5111 are in the United States and 386 in Canada; whereas the April issue gave 5464 plants, of which 5015 were in the United States and 391 in Canada. In reality the October issue contains 230 plants not previously reported, which added to 5464 would make 5694; but the discrepancy is readily explained by the discontinuance of a few plants and the consolidation of various companies into one larger system, a process that is naturally going on all the time.

Of the 5111 American plants in the October issue, no fewer than 2847 carry electrical supplies as a part of their business. Of the 386 Canadian plants, the proportion is much larger.

being 213, or nearly two-thirds. It is obvious that the size of the plant has a controlling influence on this condition, the smaller plants necessarily handling supplies in towns where there is not enough business to support a supply house. Of the 63 plants in Mexico, however, only 24 deal in supplies.

An attempt has been made in the October issue to distinguish various groups of plants by their broad characteristics of simple plants, transmission plants, lighting and transmission, and railway, lighting and transmission. The plants are also distinguished as to water, steam and gas power, and as to direct or alternating current, the latter being subdivided as to single-, two- and three-phase. The results are not yet as clear and full as could be desired, chiefly due to the lack of data from the reporting company. A renewed effort is being made to establish the distinctions and differentiations as to prime power, and the phases, more accurately. The natural tendency to group all that do not report nature of power as "steam," or that do not report phase, as "three-phase," carries with it possible errors that it is well to avoid, if possible.

Of the 5111 American plants 102 report themselves as being transmission systems pure and simple; 225 report as being lighting and transmission, and 223 as railway, lighting and transmission. This would leave 4561 ordinary self-contained lighting plants that do not undertake anything but the supply of lighting and stationary motor service; many of them, of course, having day circuits. The 102 transmission plants are tied to various local companies, but many supply current to isolated mines, factories, etc. There is considerable difficulty in determining which of the combination systems are essentially transmission, for the reason that while many of them use high voltages, step-up and step-down transformers, substations and the other paraphernalia, they are not necessarily "long distance" transmission plants. A further analysis of the Directory shows, for example, that 900 of the American plants report themselves as using water power, but it would evidently be incorrect to associate all of them with "long distance" methods. An exact definition of "transmission system" seems to be needed, especially as there is nowadays a general inquiry as to the number and names of plants falling properly within that category.

Care of Train Lighting Storage Batteries.

A committee of the Association of Car Lighting Engineers made a report to that association at its convention at Chicago in November on the "Care and Maintenance of Storage Batteries." In discussing the relative advantages of lead-lined tanks and rubber-jar tanks, the committee stated that the former withstand severer shocks, cost somewhat less, the salvage is more, and they can be repaired more readily than the latter, while the rubber-jar tanks require no special care to prevent the action of wood acids and grounds, require no insulation to prevent the short-circuiting of the groups, they weigh somewhat less than lead-lined tanks and the tendency of the electrolyte to creep is much less.

The committee stated that lead linings should be made of lead weighing not less than 4 lb. per square foot, with all laps formed by turning, while rubber jars should be not less than 3/16 in. in thickness with reinforced tops.

In discussing the washing of batteries the following method was suggested: First, see that the batteries are fully charged. Then provide an extra tank or other container suitable for immersing plates. Remove the element from one jar or tank and take out the separators, making sure the plates are free from any particles liable to cause short-circuits. Replace the old or apply new separators and put the element in the clean extra jar which has previously been filled with acid of proper gravity. Special care should be taken to see that the plates are kept out of the acid as short a time as possible. The air acts upon the negative, causing it to heat rapidly and lose its charge. If the operation is quickly performed, this method will be found very efficient. The battery should then be charged until the gravity has ceased rising and remains stationary for one hour.

The strength of acid under proper conditions and the same charge should continue nearly uniform, weakening very slowly. If the acid is too weak on arrival of the car the cause should be investigated and a charge given, the cause being removed. If the battery has been discharged below 1.8 volts per cell with all of the lamps on, a long charge should be given at normal rate until the gravity becomes stationary. The batteries should be flushed with distilled water up to the standard height as often as necessary, the gravity and voltage with lamps on being read at that time on all of the cells if the service has not been up to standard. If the gravity is lower on any particular cell than on the others, the cause should be located, as the cell may be short-circuited or may have impurities in the electrolyte.

The pilot-cell method of operation, which has been used on one or two large roads, involves the selection of one or two cells in each set as standard to indicate the condition of the whole battery. The height of the electrolyte must be kept as near constant as possible in order to get reliable readings. The condition of charge of the cell is indicated by the gravity, if the gravity at full charge is known. It should be borne in mind that the gravity method is more reliable than the voltage method, since it does not vary with the amount of current.

The use of batteries in parallel should be avoided when practicable, as cells or sets do not divide the load properly unless all the cells are equal in charge, capacity and general condition. A bad cell may so weaken one set that the other sets will discharge through it, reducing the charge seriously. When sets are used in parallel it is advisable to test the sets separately. If one set is doing the large proportion of the work, the gravity and height of electrolyte will be different in the set. It is advisable to change parallel sets to series when practicable for charging at terminal stations. This insures the same charge being put in each set.

A good cadmium stick furnishes a means for determining whether the positive or negative plates are at fault in a cell lacking in capacity. Special care should be taken in making this test. The method generally used in making this test is to encase a small cadmium stick in suitable perforated rubber, a voltmeter lead having been previously attached to the stick. The cadmium is then placed across the tops of the plates, completely immersed in the electrolyte. The voltage is then read between cadmium and the positive and between cadmium and the negative; the allowable variations in these readings should be ascertained from the battery manufacturer. The cadmium test piece, if new, should be well seasoned by several hours' immersion in electrolyte. A few minutes should be allowed for the cadmium readings to become constant. The voltmeter should have a finely divided low reading scale.

DISCUSSION.

In the discussion of the report considerable difference of opinion was brought out as to the relative merits of rubber jars and lead-lined tanks.

Mr. Fred. McGary, of the Burlington Route, favored lead-lined tanks.

Mr. C. W. Bender, of the Pennsylvania Railroad, said that he had never experienced a failure on a car because of leakage or terminals coming loose since using lead lining. Some of the members brought up the point that hard rubber crystallizes under vibration. Mr. F. R. Frost, of the Santa Fé Railroad, said that in seven years' use of jars ⅛ in. thick there was no crystallizing effect.

Mr. C. R. Gilman, of the Chicago, Milwaukee & St. Paul, said that in eight years' service with rubber-jar cells there had been less trouble than with any other part of the train lighting equipment and less trouble than with lead-lined tanks.

Mr. D. V. Cartwright, of the Lehigh Valley, reported that out of 476 rubber jars in 25 cars only three had broken. Some trouble had been experienced with the old jars.

Mr. W. E. Ballentine, of the Rock Island Route, expressed the opinion that rubber jars with reinforced tops are good and represent an improvement over lead-lined tanks.

Mr. George B. Colegrove, of the Illinois Central, objected to

rubber jars because of the possibility of breaking them if the trays were accidentally dropped.

Mr. Fred. McGary, of the New York Central Lines, referred to a recent wreck where four sleepers equipped with lead-lined tanks were turned over on their sides. The electric lamps continued to be used from 2 a. m., the time of the wreck, until daylight and supplied light two hours after dark on the following evening. The discussion was continued along these lines until it appeared that those using rubber jars of proper thickness properly imbedded in compound were having as little trouble as those using lead-lined tanks. While it would be difficult to renew a rubber jar in an out-of-the-way place, it would be equally difficult to secure an expert in lead burning for repairing a lead-lined tank.

On the following day a vote was taken on a resolution to the effect that it was the sense of the meeting that reinforced rubber jars, properly set in petrolite, or other suitable compound, were superior to lead-lined tanks. This resolution was lost by a vote of 11 to 12, showing the members present to be about equally divided on the subject.

There was also some discussion on the preservation of wood used in battery boxes. From this discussion it appeared that the only effective preservative must be a smooth, glossy surface of paint or compound, and that wood cannot be impregnated so that it will not be porous and allow acid to enter.

Storage Battery Cars of the Prussian State Railways.

Tests conducted by the Prussian State Railways with storage battery cars have resulted so satisfactorily that additional locomotives of the same type have been constructed for use in suburban service and in thinly populated districts where the traffic is too light to compensate for the erection of an overhead system.

A view of a complete car consisting of two half-units is given in Fig. 1. The battery consists of 168 Akkumulatorenfabrik cells in two compartments in front of the motorman's cabin. The total e.m.f. is 310 volts and the rating 368 amp-hours. It is said that a distance of 62 miles may be run on one charge, and a maximum speed of 31 miles per hour can be obtained on the level.

The propelling equipment consists of two interpole series motors of the totally enclosed water-tight type, rated at from 50 hp on the two-hour basis to 85 hp on the one-hour basis.

Each double unit is provided with two controllers, one being placed in each motorman's cabin. Under starting condition the motors are in series, while at full speed they are in parallel. The controller handle is fitted with a "dead man's" releasing device. In order to start the motor the driver must press down the controller handle, which, under normal conditions, is held upward by a spring. This operation closes two contacts, which in turn close the main circuit of an automatic circuit-breaker. It is worthy of note that special exertion on the part of the motorman is not necessary, because the weight of his arm is sufficient to press down the handle.

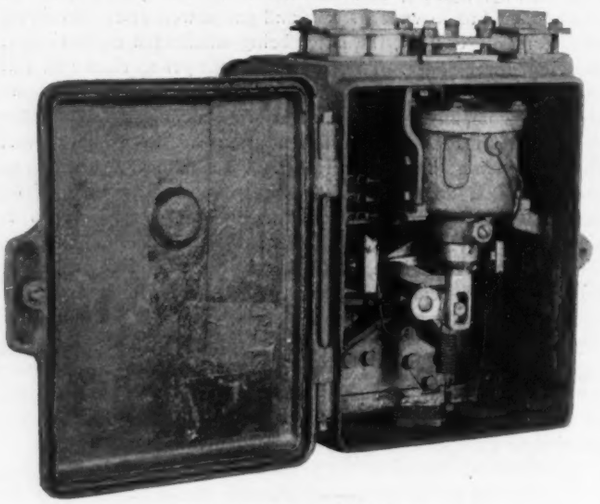


FIG. 2.—CIRCUIT-BREAKER.

The automatic circuit-breaker is equipped with two coils; one of these operates to release the breaker when the current exceeds 750 amp, while by means of the other the main circuit may be closed from either of the cabins.

Motor-driven compressors supply compressed air to a Knorr air-brake system.

The weight of a fully loaded double-car is about 62 tons. It

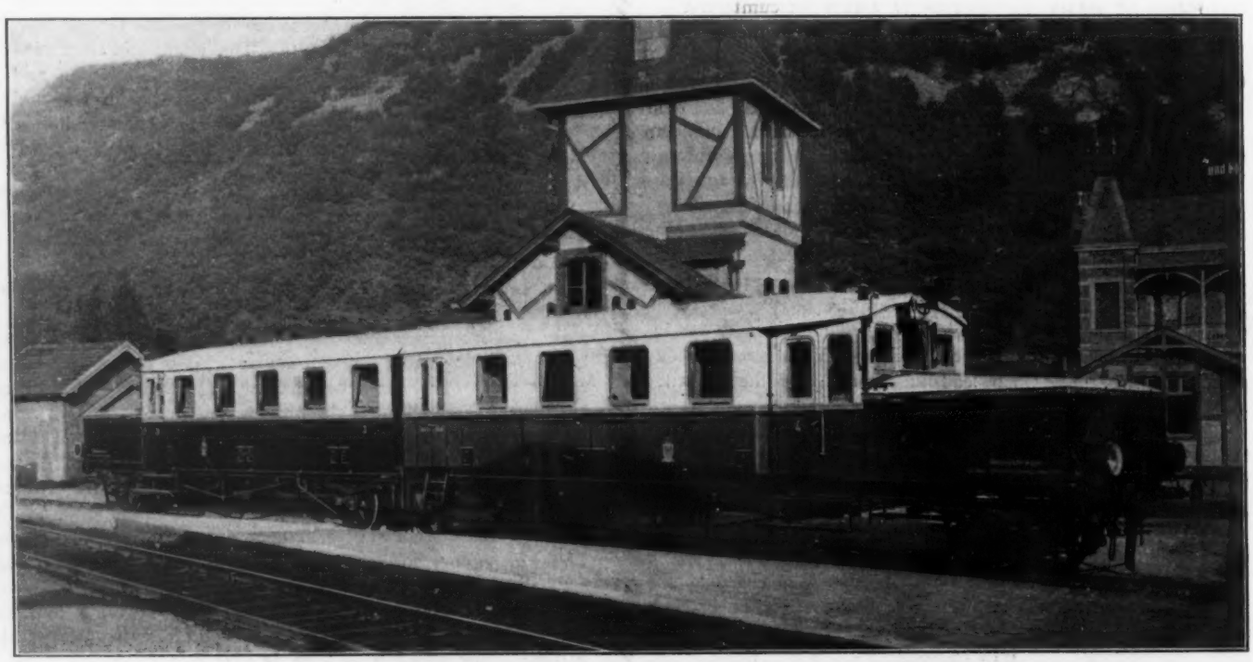


FIG. 1.—GENERAL VIEW OF STORAGE-BATTERY MOTOR CAR.

has been found that the energy used at a speed of 27 miles per hour is about 19 watt-hours per ton-mile.

The double-car has been brought to rest from a speed of 36 miles per hour in a distance of 600 ft. by the air brakes, and

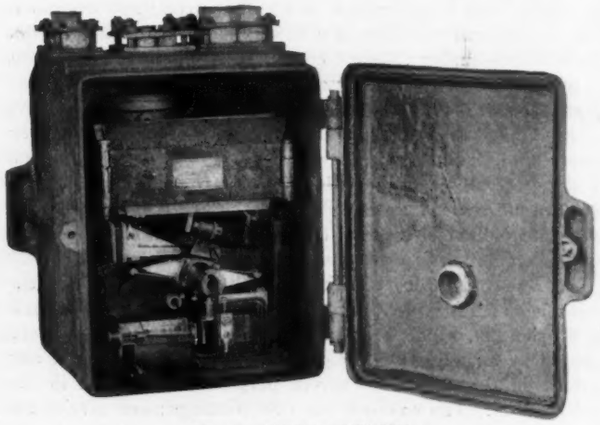
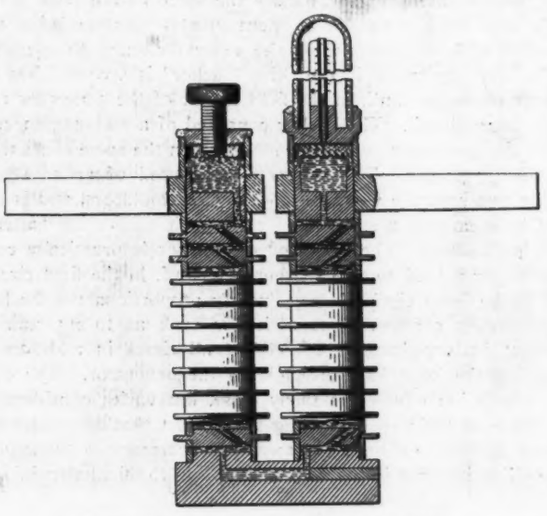


FIG. 3.—CIRCUIT-BREAKER.

in a distance of 300 ft. when the air brakes were assisted by the motors used in electrical braking. The double-cars described above were supplied by the Felten & Guilleaume-Lahmeyerwerke, Frankfort-on-Main.

Mercury Pressure Ammeter.

A patent issued Oct. 27 to Dr. E. F. Northrup covers means for utilizing the pressure in the interior of a liquid conductor carrying current. The devices make use of the so-called "pinch" phenomenon, according to which each element of a conductor is subjected to a force tending to cause it to move toward the center. Thus the liquid of a conductor will be under a greater hydrostatic pressure at its axis than at its circumference. The difference in pressure varies with the square of the current. By sectionalizing the conductor and adding the higher pressure of one section to the lower pressure of the adjacent section, a device is constructed for exhibiting the sum of the pressure differences of the various sections. A device of this kind can be



NORTHRUP MERCURY PRESSURE AMMETER.

employed as an ammeter for registering the mean effective value of the current.

The inventor states that with a liquid conductor 0.5 in. in diameter consisting of 1000 sections, a current of 600 amp will give a total resultant pressure of 43.2 lb. per square inch. An ammeter built up of copper disk elements, with mercury as the liquid for transmitting the pressure, is shown in the accompanying illustration. Passing through each of the elements in a slanting direction from the center of one face to the edge of the other face is an opening lined with an insulating tube. The column of mercury serves for transmitting the pressure accumulatively from one section to the next. A graduated vertical glass tube at the top of the device serves to indicate the total pressure of the sections, and hence by calibration shows the effective value of the current.

Electricity at the New Northern Avenue Bridge, Boston.

Electricity is the primary motive power utilized in the operation of the new Northern Avenue bridge, which connects Boston proper and South Boston. The bridge is of the draw type and designed to carry a freight railway track on a center roadway, besides the usual city traffic. The draw section is a symmetrical swing span of the rim-bearing type, 283 ft. long and 79 ft. 1½ in. between sidewalk facias. It is made up of two independent spans about 125 ft. long supported on a central tower. The tower carries the load to eight points on a circular drum 40 ft. in diameter, through a system of distributing girders, all weighing about 1300 tons, and resting on 56 steel wheels running between steel-faced tracks.

The draw is operated by compressed air at a normal pressure of 200 lb. per square inch. A power room is located on the draw, the dimensions of the chamber being 26 ft. x 23 ft., and in this compartment is installed the machinery and automatic controlling apparatus. Power is supplied through two independent three-wire cables of the submarine type connected with the distribution system of the Edison Electric Illuminating Company of Boston, the double supply being for flexibility and continuity of service. The cables are separated in the water by a maximum distance of about 200 ft. There are two Ingersoll-Rand two-stage compressors, each having a capacity of 192 cu. ft. of air per minute at 200 lb. per square inch pressure. The compressors are each gear-driven by a 50-hp General Electric 220-volt direct-current motor, the motor speed being 560 r.p.m. The compressors pump directly into a 4-in. main pipe leading to the center of the draw and into eight receivers in another chamber, which have a combined capacity of 1500 cu. ft. of air. From the 4-in. main, the air, after passing through a reducing valve which lowers the pressure to 60 lb., runs two 6¼-in. x 10-in. double-cylinder reversing engines, which in turn swing the draw, operating through a convenient train of gears and a pinion working in a rack fixed to the lower track.

The end-lifting device consists of a lever suspended below the bottom chord at the outer end of each truss operated by a 16-in. vertical air cylinder. These cylinders take air direct from the compressors at a pressure of 180 lb. to 200 lb. per square inch. The ends of the draw, after having been raised, are lowered upon flat blocks, thus giving perfect rigidity when the draw is in place for street traffic. These blocks are pushed in place by the gateman, who operates a lever from the deck of one of the spans. The turning and lifting devices are controlled by the operator from a convenient standpoint on the deck by means of a simple arrangement of levers and valves. The air compressors are arranged to start and stop automatically by a Cutler-Hammer controller installation whenever the pressure varies 15 lb. from normal. About 250 tons are lifted at each end of the draw. A Buffalo motor-driven centrifugal pump rated at 1.5 hp is provided to supply cooling water for the compressor jackets. A tank is provided in the machinery room, which supplies each compressor with water through a ¾-in. pipe, the returns to the tank being brought through a 1½-in. line. The automatic controller is designed to start the circulating pump in case either compressor motor begins to operate, and to stop it at the conclusion of the former's service. The installation was designed by the Engineering Department of the city of Boston.

New Western Telegraph Company.

The People's Mutual Telegraph Company, organized by a number of Board of Trade operators from Chicago, St. Louis and Kansas City, has asked the Chicago City Council for an ordinance granting it the right to negotiate contracts with the Metropolitan Elevated Railroad for stringing wires on its elevated structure and with the Commonwealth Edison Company for using its conduits within the city limits. It is understood this company was organized to build and operate a commercial telegraph system in opposition to the existing commercial lines. The organizers claim the new telegraph system will amalgamate many of the independent telephone systems between Chicago and Kansas City by way of St. Louis. The line will be used for the transmission of messages between the business centers of the three cities named, and it is claimed will be in operation within six months after the ordinance asked for is granted. W. S. Jackson, at one time president of the Chicago Board of Trade, is urging the passage of the ordinance.

"Axle" Lighting for Railroad Trains.

A committee on axle lighting, consisting of Messrs. A. Chester Terry, W. Barnes and R. W. Massey, made a very comprehensive report at the convention of the Association of Car Lighting Engineers, at Chicago, Nov. 16, 17, 18 and 19, 1908. The report opens with a brief description of the methods of regulation and the distinctive features of the various devices which have marked the progress of this branch of train lighting, as noted below.

The consolidated type A equipment consists of a 35-amp, 30-volt shunt-wound generator, the voltage regulation of which is accomplished by a rheostat in the field circuit. The rheostat is automatically operated by a small motor and a pair of ratchet wheels and pawls which are controlled by a solenoid carrying the generator current. The voltage regulation thus accomplished is practically constant for all train speeds.

The mechanism for the regulation of current to the lamps consists of a resistor of permanent resistance which is cut in series with the lamps when the generator starts to operate. The resistor was sometimes divided into adjustable sections and connected so that when each circuit switch was turned on a section was short-circuited. With this device the lamps are protected from the extreme high voltage to which they are subjected with no regulation, but it leaves much to be desired in the way of perfect voltage regulation, as the variations in voltage are still large and the fluctuations when the resistors are cut in and out are very noticeable.

The old Gould equipment consisted of a 25-volt shunt-wound generator mounted on the bottom of the car. The slipping of the belt was depended on entirely for regulation, the machine being so mounted that the tension on the belt could be regulated by a crank in the car floor. There were two sets of batteries with this device, and while one was being charged the other was connected to the lamps.

Several patents have been taken out for, and some experimenting has been done with, devices using compressed air from the train line to operate rheostats in the field and lamp circuits. The air valves were controlled by solenoids which would operate to maintain a constant generator output and a constant lamp voltage. No satisfactory practical results have been obtained with these devices.

There have been brought out several devices which operated on the principle of maintaining a constant generator voltage instead of a constant current. With this type of device if the generator voltage is such as to charge the battery at its normal rate at the beginning of the charge, it is evident that the charging current will gradually taper off and a much longer time be required to charge the battery than is desirable. The result would be that the battery would almost never get a full charge under the average conditions of service. This is not only injurious to the battery, but the full capacity of the battery is at no time available in the event it is needed. On the other hand, if the generator voltage is sufficient to charge the battery at its normal rate at the maximum voltage, the early part of the charge will be at an excessive rate and the amount of overcharging will also be excessive. A fact which evidently did not receive due consideration in the design of these devices is that the maximum voltage of a battery is not a fixed value, but varies widely under different conditions, including temperature, so that a device which maintains a constant generator voltage cannot produce the best results.

The United States equipment uses a shunt-wound 1.5-kw generator designed for 30 or 60 volts. The voltage regulation of the generator is accomplished by varying the mechanical pressure on a pile of carbon disks in the field circuit by means of a solenoid which carries the generator current. No lamp voltage regulation is attempted.

The Newbold device consists of a shunt-wound 2.4-kw generator wound for 30 or 60 volts and a regulator having a field-circuit rheostat, which is operated by the pull of a solenoid core opposed by an adjustable weight. The action is such that any increase in the generator current puts more resistance in the field rheostat. The solenoid has two windings; one carries the machine current, while the other, which is wound in opposition to the first, carries the lamp current. Thus, when the lamps are in use the generator output is increased in proportion to the lamp load.

The lamp regulation is practically the same as described with the Consolidated type A equipment. A special switchboard is usually provided having three-pole circuit switches, the third pole being used to short-circuit the sections of resistance as previously described.

The Bliss type F equipment consists of a 3-kw shunt-wound generator designed for 30 or 60 volts and a regulator which has two resistors of constant resistance in multiple with each other and in series with the field winding. Each one of these resistors is short-circuited by a carbon-pencil contact. The lower carbons are mounted on solenoid cores. The main windings of the solenoids carry the generator current and the second windings the lamp current, as is the case with the Newbold equipment. The solenoids thus control the mechanical pressure on the carbon-pencil contact and vary the degree of short-circuiting of the resistors in the field circuit; the action is such as to maintain a constant generator current. The regulation effected varies considerably with different train speeds. The lamp regulation is practically the same as the ones previously described, a resistor of permanent resistance being put in series with the lamps when the generator starts to operate.

The load regulation in the Bliss "bucker" is accomplished by inserting counter e.m.f. in the field circuit of the generator and in the lamp circuit. The bucker consisted of a motor connected across the generator mains and mounted on the same shaft with the bucker proper. The bucker is composed of an armature having two separate windings and two commutators, and is excited by means of a series field coil which carries the battery-charging current. The speed of the bucker is practically constant under a load so that the counter e.m.f. in the field circuit and in the lamp circuit is very nearly proportional to the battery-charging current. The action is such as to maintain a constant battery-charging current at all times in addition to supplying the lamp load direct from the generator. The current regulation effected is fairly close, but varies considerably for different train speeds owing to the fact that successive increases in battery-charging current are necessary to cause corresponding increase in the counter e.m.f. in the field circuit. As the counter e.m.f. in the lamp circuit is proportional to the battery-charging current and is not dependent directly on the actual battery voltage it is evident that variations of battery voltage during charge and from other causes previously mentioned will cause a considerable variation in the lamp voltage.

The Consolidated type D equipment consists of a 3-kw generator designed for 30 or 60 volts, the voltage regulation being accomplished by a rheostat in the field circuit, which is automatically operated to maintain a constant current. The cur-

rent regulation accomplished is very close and is constant for all train speeds. The e.m.f. at the lamps is maintained within a variation of 1 to 1.5 volts, by means of an automatically-operated rheostat in the lamp circuit. A high-resistance electromagnet connected across the lamp circuit operates by means of a small motor and suitable mechanical devices to cut in or out resistance in the lamp circuit on a very small voltage variation. This means of regulation is positive and maintains the lamps at normal voltage regardless of any change of conditions in other parts of the system. The only deficiency in this regulation is that its action is not instantaneous; when a considerable number of lamps are turned on or off a few seconds are required for the rheostat to readjust itself.

An improvement on this regulator, which has recently been brought out, acts on the principle of an ampere-hour meter, and records the charge and discharge of the battery on a paper roll, giving a complete record of the performance of the apparatus as well as indicating the amount of charge in the battery at any time. It charges the battery at its normal rate until about 25 per cent overcharged and then automatically cuts out the generator or cuts down the current to a very small value, as desired. As soon as the lamps are burned for half an hour the generator is again cut into service. When there is only an hour's charge at the normal rate left in the battery, all lamps except an emergency circuit are cut out, and when 1.8 volts per cell is reached all of the lamps are cut out. The battery is thus charged at its normal rate and is protected from overcharge and overdischarge, which arrangement is certain to add materially to its life. No change of adjustment of the generator current is necessary when a car is transferred from a nearly all-daylight run to an all-night run as the different conditions resulting are taken care of automatically. So far as the regulation is concerned the battery receives very nearly an ideal treatment with this device.

During the first few years of axle car lighting all types of generators except the Gould were mounted on the inside of the truck, while at the present time the outside suspension is almost universal, and within the past two years practically all other methods of drive have been abandoned in favor of the use of the plain rubber belt now employed.

The best results are obtained in electric car lighting, as in any other department of a railroad, by having a competent man in charge who is familiar with the details and requirements of the service. The services of such a man are just as necessary in deciding on the type and details of apparatus to be purchased as in superintending the maintenance, for it is evident that the difficulties which result from a lack of knowledge and experience in selecting material cannot be overcome after the purchase has been made.

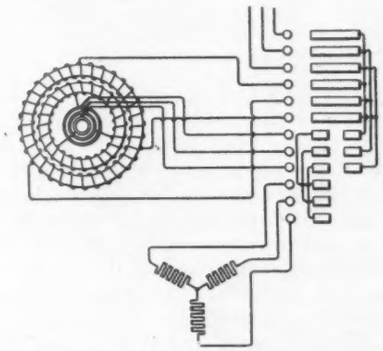
The committee gave a table showing the costs of maintenance based on actual labor and material. On one road operating 30 cars the average cost per car-month was $30; on another road using 80 cars, the cost was $26.33 per car-month; on a road operating 16 cars, the cost per car-month was $8.66, while on a road operating 80 cars the cost was $8.61 per car-month. The equipments of the last two roads are less than two years old, so that no battery renewals have been necessary.

Induction Motor Performance.

In a patent issued on June 15 to Mr. R. H. Parker the inventor states that an induction motor with coil-wound secondary exhibits an improved performance if instead of closing the rotor winding upon itself it be joined in reversed-parallel with the stator winding, the two windings being subjected to the normal supply e.m.f. It is claimed that the motor thus connected operates synchronously at a speed somewhat below synchronism like an ordinary induction motor and may be considered as in reality two motors in one.

The polyphase currents supplied to the stator produce a rotary field which revolves synchronously with respect to the stator, and induces in the rotor, which revolves at a certain slip below synchronism, low-frequency alternating currents, as in the usual induction motor. If both windings are connected in parallel to the source, the stator winding serves to complete the circuit of the rotor for the low-frequency currents, and since the induced rotor currents are of very low frequency, the impedance offered by the stator winding to these currents is small and the rotor acts with respect to these currents as though it were directly short-circuited. In other words, the rotary field produced by the currents supplied to the stator produces an induction motor action in the usual way. A second rotary field, moreover, exists in the motor, produced by the currents supplied to the rotor. This field revolves at a synchronous speed with respect to the rotor, and in a direction opposite to the rotation of the rotor and of the stator rotary field. Since the rotor is moving at a speed somewhat below synchronism, this second rotary field revolves in space at a speed corresponding to the slip of the rotor and in a direction in space, or, in other words, with respect to the stator, opposite to the direction of rotation of the field produced by the currents supplied to the stator. This second rotary field consequently induces in the stator winding low-frequency secondary currents which find a closed path through the rotor winding.

If the stator and rotor windings are connected directly in parallel to the same source, the low-frequency currents induced



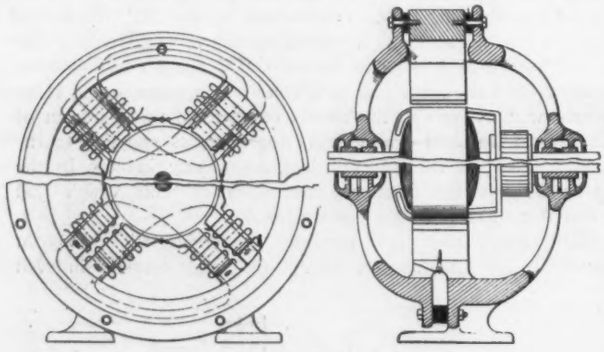
PARKER INDUCTION MOTOR SCHEME.

in both windings are in time-phase with respect to the closed local circuit formed by the two windings and consequently form a single resultant low-frequency current in the two windings in series. A second induction motor action is thus produced by this second rotary field.

The efficiency of a motor operated in the above manner is stated to be greater than that of an ordinary induction motor, and also its maximum output is greater. The reason for this is, first, that the magnetizing currents are divided equally between the two windings, and, secondly, the ohmic loss in each winding is not the sum of the ohmic loss which would be produced by each current singly, but instead, is only the square-root of the sum of their squares. This follows from the well-known law that when a conductor is traversed by an alternating current and a direct current, or by two alternating currents of different frequency, the ohmic loss is not the sum of the losses which would be produced by each of the currents singly, but is equal to the square-root of the sum of their squares. Consequently, for a given load on the motor the energy wasted in heat due to ohmic drop is less than in an induction motor operated in the usual manner—or, stated in another way, for the same amount of heating, a machine operated in accordance with the above-mentioned scheme will carry a greater load than a machine operated in the usual manner with current supplied to only one winding and the other short-circuited. The machine is started from rest as an induction motor with only one winding connected to the source of current and the other short-circuited through resistors in the usual manner; when the motor is up to speed, the second winding is connected to the source in parallel with the first, the connections of the phase being relatively reversed. The connections are indicated on the accompanying controller diagram.

Composite Fields for Generators.

A patent has been granted to J. P. Nikonow covering a new design of composite fields for generators. As the accompanying illustrations show, the field is composed of separate parts in order to eliminate the armature reaction by increasing magnetic reluctance for the cross-magnetizing magnetic flux. There are several prior patents on the same feature of design, but in all the separate parts of the poles have been attached to the same yoke, so that the cross-magnetizing flux could find an easy path through the yoke. In the present patent this trouble is claimed to be eliminated by using not only divided



COMPOSITE FIELD FOR GENERATORS.

poles, but also separate yokes, so that the main flux is divided in completely separate paths, large reluctance being interposed for the cross-magnetizing flux. In the first modification shown the main body of each pole is connected to the main yoke and additional parts on the poles to the auxiliary yokes formed with the side brackets of the dynamo. In the second modification each pole is composed of two parts combining side yokes.

In case of compound-wound machines it is of decided advantage to put the series coil on one-half of such a composite pole only, because then the series winding will improve more effectively the magnetization curve. In the case of ordinary slotted poles such partial winding would build a strong local flux, badly distorting the main flux.

CURRENT NEWS AND NOTES.

ELECTRICAL TRADES SOCIETY.—The twelfth annual meeting of the New York Electrical Trades Society will be held at 2 p. m., Dec. 8, at the Electrical Club, 14 Park Place. Reports will be read, matters of interest as to credits will be discussed and three directors as well as a national delegate will be selected.

STEINMETZ ON ILLUMINATION.—At the next regular monthly meeting of the New York section of the Illuminating Engineering Society, Dr. C. P. Steinmetz will deliver a lecture on the subject "Illumination and Illuminating Engineering." The meeting will be held on Thursday, Dec. 10, in the Engineering Societies Building, at 8:15 p. m.

CINCINNATI ELECTRICAL SHOW.—A Western-Southern Electrical Show is proposed for Cincinnati, Ohio, to be held March 13-27, 1908. About 30 per cent of the space is already taken up. The exhibition is promoted by a number of the leading electrical manufacturers and supply houses of the vicinity, and in view of the prominence of Cincinnati as a machinery center the show should be well supported.

MEMORIAL TO AMPERE.—A bronze and tile memorial tablet in honor of the great French scientist, Andre-Marie Ampere, has been set up in the Lackawanna Railroad station at Ampere, N. J., by Dr. Schuyler Skaats Wheeler. This memorial will be unveiled by His Excellency Monsieur Jusserand, the French Ambassador—who will come from Washington expressly for the occasion—at 3 o'clock Thursday afternoon, Dec. 3. Andre-Marie Ampere, whose name is used throughout the world to designate the unit of electric current, was born at Lyons, 1775, and died at Marseilles, 1836. Ampere, N. J., is the only place in the world named after this distinguished Frenchman, and the tablet is probably the only memorial raised to his honor outside his own country.

ITHACA SECTION, A. I. E. E.—The second regular meeting was held on Thursday, Nov. 19, with 130 members and visitors present. Prof. H. H. Norris gave an experimental demonstration of "Atmospheric Insulator Losses in Transmission Lines." Various corona effects were shown, and by means of wattmeter measurements the corresponding power losses were determined. The 60,000-volt transformer used in these experiments was the one designed and constructed by Prof. H. J. Ryan, and used in his famous experiments. This demonstration was appropriate in view of the recent discussion of Mr. Mershon's Atlantic City paper before the local section.

PUBLIC UTILITY LAW.—Mr. William M. Ivins, who was special counsel for the New York Public Service Commission in the Interborough-Metropolitan investigations, is joint author with Mr. Herbert D. Mason of a 1200-page volume entitled "The Control of Public Utilities." The New York State law on the subject is accompanied with 700 pages of notes from the leading American and English decisions. The views of the courts in New York and other states are set forth, together with the findings of the Federal judiciary under provisions of the Interstate Commerce act analogous to the state laws. The rulings of the Interstate Commerce Commission and the two Public Service Commissions in this state, and the boards and commissions which preceded them, complete the interpretation.

LIGHTING BUCYRUS, OHIO.—Another legal controversy has developed in the attempt of the city council of Bucyrus, Ohio, to install a municipal lighting plant. The matter had been placed before the people, who voted in favor of it, and the bonds, amounting to $80,000, were about to be sold, when an injunction was secured against further action by T. M. Droleabaugh, a taxpayer. Eight bids had been received, but the action of the court prevented any award being made. By some it is thought that the company which now has the contract for the city lighting is behind the legal action, but this is not known. It is said that the city council will make no contract with the old company should it be found that it had anything to do with the suit; although the town will be dark after March 1 of next year, if the contract is not renewed, since energy can be secured from no other source.

INDIANA ACADEMY OF SCIENCE HOLDS MEETING.—The Indiana Academy of Science held its twenty-fifth annual meeting at Purdue University, Lafayette, Ind., during the week beginning Nov. 27. Prof. Glen Culbertson, of Hanover College, president of the association, delivered the annual address, taking for his subject "Deforestation and Its Effects." A number of round-table talks were had on various scientific topics, and a systematic inspection of the various departments and buildings of the college were made. The night session of the first day was held in the lecture room of the electrical building, where a large number assembled to hear a lecture and demonstration by Professor Plumb, professor of electrical engineering at Purdue, on "High-Frequency Currents." The meeting was better attended than any previous meeting held by the academy. Arrangement has been made to have all the educational associations of the State represented at its meeting next year. The officers elected for next year are: President, A. L. Foley, of Indiana University, Bloomington; vice-president, Prof. Percy N. Evans, of Purdue, Lafayette; secretary, Prof. J. H. Ransom, Purdue University; assistant secretary, A. J. Bigny, Moores Hill; treasurer, W. A. McBeth, Normal School, Terre Haute.

Municipal Electric-Light Plant at Fort Wayne, Ind.

THERE has recently been placed in operation at Fort Wayne, Ind., a modern municipal electric-light plant, designed and built especially for the purpose of supplying energy for lighting the city's streets in an efficient manner and for lamps and motors in the public buildings, such as the City Hall, Public Library, schools and fire departments.

The station is located on Clinton Street, in the northern part of the city, and the building was erected on the site of the old boiler room of No. 1 pumping station, the largest station of the city waterworks department. The old boiler house, brick stack and four small return-tubular boilers were removed and the waterworks pumps now receive steam from the boilers in the electric-light plant. The site selected for the plant is about 300 ft. west of a small creek, Spy Run, so that by building a concrete dam across the creek and thus raising the water level 5 ft. a large storage basin was formed. The water backs up through a 30-in. pipe into an old reservoir between the creek and the plant, where it is available for circulating water for the condensers.

Coal is brought to the plant over the Lake Shore Railroad on a side track which extends through the building along the west boiler-room wall, and is carried on a steel structure supported by the concrete building walls and by concrete piers north of the building for a distance of 75 ft., making the coal storage capacity of the plant about 530 tons. The coal is dumped directly into the coal pockets from bottom-dump cars.

The station building is a concrete and brick structure 135 ft. 7 in. x 70 ft. in plan, 26 ft. 6 in. high from floor line to roof trusses, which are of steel, supporting a slate roof. The brick walls are 12 in. thick, except those of the coal room, which are 16.5 in. thick. The sills, window arches, trimmings and coping are of Bedford stone. A 12-in. brick wall divides the station into a boiler and a turbine room, 57 ft. 1 in. x 70 ft. and 56.5 ft. x 70 ft., respectively, in plan.

The boiler room contains three Bonson boilers, of a combination water- and fire-tube type, each rated at 350 hp, and built for 160-lb. working pressure. Two boilers are set in one battery and one is set singly with space for an additional boiler. The settings are of dark buff glazed brick, the shells and front water legs being covered with 85 per cent magnesia plaster, 1 in. thick, protected with heavy canvas. The boilers are equipped with Roney stokers in the standard stoker furnace, which also has a special tile roof as far as the bridge wall. During the recent performance tests made by the consulting engineer, the boilers developed from 116 per cent to 131.5 per cent of the builder's rated horse-power, and while being worked at from 50 per cent to 135 per cent of rated capacity, smoke never exceeded a thin gray vapor and most of the time was not visible. Hocking Valley nut, pea and slack coal mixed is the fuel used at the present time. Coal is brought to the stokers from the coal room or storage yard in Koeppel 1-ton charging cars running on a 24-in. gage track imbedded in the concrete floor and laid on a cinder foundation outside of the building to the coal yard. Two sets of track scales are provided for

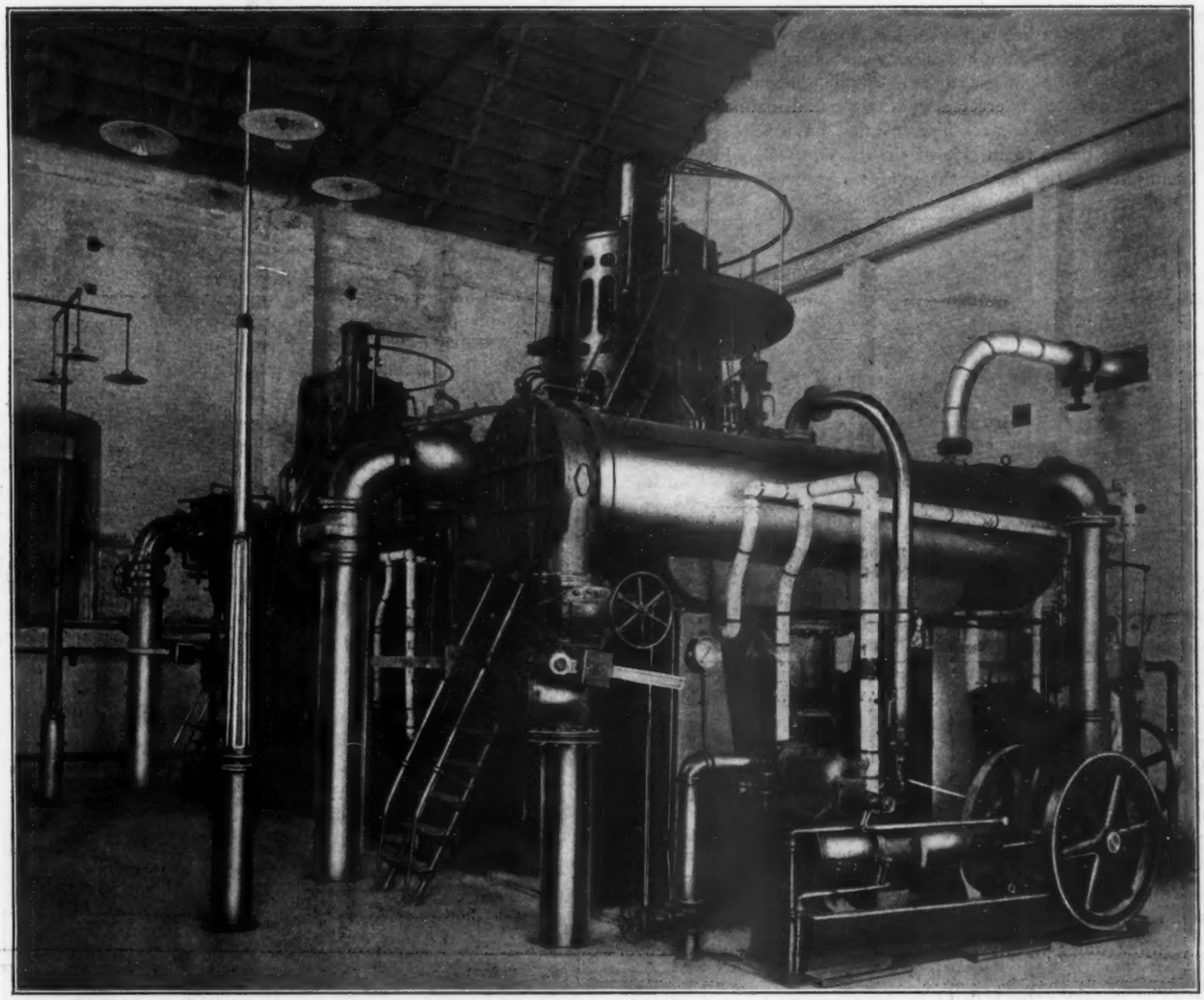


FIG. 1.—TURBINE ROOM, SHOWING TWO 500-KW UNITS.

weighing coal and ashes. The ashes are shoveled from the pits into side dump cars and removed to the north end of the lot on the narrow-gage coal and ash track.

A No. 8 steel breeching extends across the tops of the smoke boxes at the front of the boilers and connects into the stack, which is located in line with the boiler fronts, 8 ft. from the north boiler-room wall. The stack was built by the Alphons Custodis Chimney Construction Company, and is 160 ft. high and 6.5 ft. inside diameter at the top. The foundation is concrete, 20 ft. square at the bottom and 14.6 ft. at the top, with a depth of 9 ft. The feed-water equipment, which is also located in the boiler room, consists of an 800-hp Cochrane feed-water heater and two compound, duplex Epping-Carpenter steam-driven pumps, built for 175 lb. working pressure. One pump easily supplies the boilers installed. A feed-water temperature of 210 deg. Fahr. is obtained in the heater, utilizing practically all exhaust steam from the turbo-exciters and condenser auxiliaries. The feed-water piping is so arranged that the boilers may be supplied directly from the city mains or by either pump from the heater, city mains or reservoir.

The steam piping lay-out is simple, but all pipe work is extra heavy and is erected in a substantial manner. The main header is a 10-in. steel pipe, carried on brackets and rollers along the boiler room side of the division wall. Each boiler is connected to the header through two gate valves by a U-bend

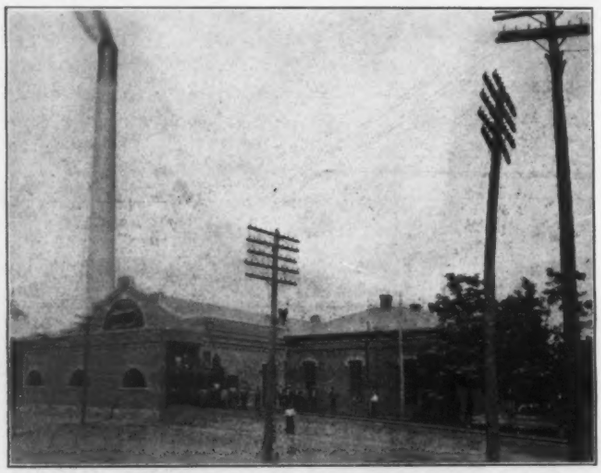


FIG. 2.—EXTERIOR VIEW OF FORT WAYNE, IND., MUNICIPAL LIGHT PLANT.

of 8-in. pipe. Steam is supplied to the turbines through 6-in. pipes taken from the side of the header and the auxiliaries of each unit are supplied through separate 3-in. mains, taken from the bottom of the header. These auxiliary mains also serve as drain pockets, and in them are placed Cochrane steam separators, which are trapped to the heater. All the necessary valves are provided for the convenient control of the boilers and branch lines from the header. All live steam and boiler-feed hot-water pipes are covered with sectional magnesia covering.

The turbine room contains two 500-kw generating units, condensers, auxiliaries, exciters, oil pumps and filter, switchboard, arc transformers and mercury-arc rectifiers, with space for an additional 500-kw unit. All machinery is placed on one floor level, except the oil-cooled rectifying apparatus, which is mounted on gas-pipe frames above the regulating transformers, so that everything in the turbine room is under the eyes of the operating force, and the auxiliaries receive more attention than they would if placed in a basement or pit. The entire turbine room is served by a 5-ton, hand-operated traveling crane, built by the Northern Engineering Company. The generating units are standard General Electric Curtis turbo-alternators, built to run at 1800 r.p.m. with 160 lb. steam pressure. The alternators are three-phase, 60-cycle, 2300-volt, separately-excited machines. The turbine governor is of the improved hydraulic type, operated by oil from the high-pressure oiling system. The flow of oil in the governor cylinder which controls the steam inlet valves is controlled by a small valve operated by the centrifugal governor on top of the turbine shaft.

Each turbine exhausts into an Alberger counter-current sur-

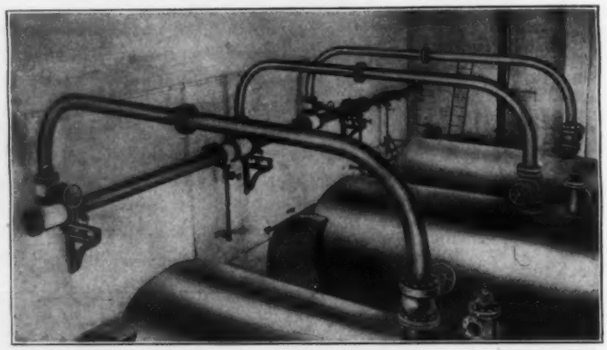


FIG. 3.—STEAM HEADER AND CONNECTIONS TO BOILERS.

face condenser mounted on concrete piers adjacent to the turbine. Each condenser contains 2000 sq. ft. of cooling surface and is guaranteed to produce a vacuum of 2 in. absolute while condensing 10,500 lb. of steam per hour when supplied with 1200 gal. cooling water per minute at 80 deg. Fahr. During the performance tests, one condenser maintained a vacuum of 1.2 in. absolute while condensing 10,600 lb. of steam per hour, a full load being carried on the turbine and the circulating and dry-vacuum pumps at normal rated speed. The condensed water is returned to the heater from the hot wells under the condensers by steam-driven Epping-Carpenter duplex pumps. The dry-vacuum pumps are of the Alberger steam-driven, crank-and-fly-wheel type with a single air cylinder, 8 in. x 10 in. in size, discharging into the atmospheric exhaust pipe for the turbines, which is laid under the concrete floor. This relief line beneath the floor is of 12-in. and 16-in. cast-iron, flanged pipe with fittings provided for the future unit. Above the floor it consists of 12-in. cast-iron risers connecting to the relief valves of the turbines, and a 16-in. galvanized spiral-riveted pipe to discharge the vapor and steam through the north wall of the building, at a height of 24 ft. above the floor. Cooling water for the condensers is obtained through separate 12-in. cast-iron suction pipes from the reservoir mentioned above, and is supplied to the condensers by 8-in. Alberger centrifugal pumps, direct-driven by 6-in. x 8-in. Shepard vertical engines, running at a speed of 325 r.p.m. The water is discharged through separate 10-in. pipes into a 16-in. cast-iron pipe, carried

FIG. 4.—BOILER ROOM.

about 300 ft. and discharged through a Y-connection, either above or below the dam in the creek, as may be desired. The suction pipes are laid as flow lines to a point directly below each pump, making necessary considerable trench work, 22 ft. deep, and owing to the nature of the soil and the large amount of

water encountered, this portion of the work offered one of the most difficult problems encountered in constructing the plant. The main 16-in. discharge pipe from the condensers is also laid below normal water level so that the condenser piping works on a siphon system, making only a small friction head for the circulating pump to work against.

Two 25-kw Curtis turbo-exciters are installed. These are of the horizontal type rated at 125-volt, four-pole, 3600 r.p.m., and the output of one exciter is sufficient to excite both turbo-alternators under full load. Owing to the shifting nature of the soil encountered and the fact that the turbine room had been cut up with two wide ditches, 12 ft. deep, it was deemed advisable to build all turbine and condenser foundations in one mass, so that the two turbines, condensers and all auxiliaries rest on a block of concrete 36 ft. long, 19.5 ft. wide and 3.5 ft. deep, reinforced with 8-in. I-beams spaced 2 ft. centers, laid lengthwise of the foundation and placed 6 in. from the bottom of the concrete.

Oil is supplied to the bearings of the turbine and to the valve-operating mechanism by two Worthington steam-driven, duplex high-pressure pumps. A pressure of 200 lb. per square inch is maintained on the step bearing, which pressure is reduced by baffles at the other bearings. The oil returns through a 3-in. pipe laid in the pipe trench to a Turner oil filter and cooler capable of treating 12 gal. per minute. The pipe trench contains all exhaust steam, drip, drain and return oil pipes and is covered with rolled-steel floor plates, 3/16 in. thick. The oil piping is so arranged that either oil pump can take care of either turbine, or both turbines if necessary. A coil spring accumulator is installed to take care of any vibrations caused by the oil pumps.

The cables between the alternators and switchboard are carried in a 2.5-in. enameled steel conduit and between the switchboard and exciters in a 2.5-in. and 1.5-in. conduit, laid beneath the concrete floor. The switchboard is of blue Vermont marble and consists of 13 panels, as follows: one blank for a future generator, two combination generator and exciter panels, one feeder panel with fuses and oil switches for two circuits, and nine magnetite arc panels. All switches and instruments are finished in dull black and the arc-circuit ammeters are equipped with grounded protecting shields. In front of the switchboard there is imbedded in the concrete floor strips of rough skylight glass, 1 in thick, 4 ft. wide, forming an insulated floor for the operator the full length of the board. The joints between the pieces of glass are filled with insulating compound.

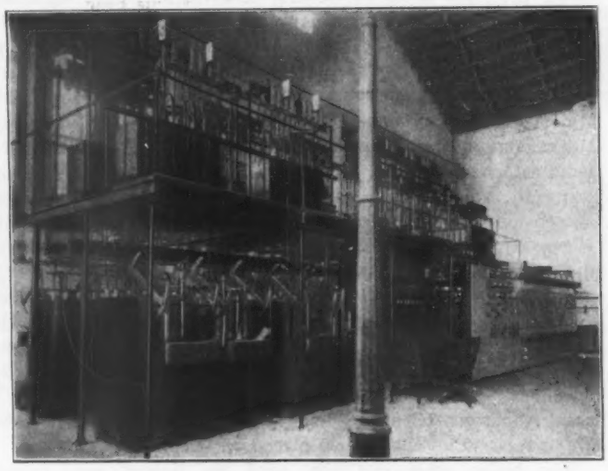


FIG. 6.—SWITCHBOARD, ARC REGULATING TRANSFORMERS AND RECTIFIERS.

The nine General Electric, 75-lamp, magnetite-arc, regulating transformers, with reactance coils, are arranged in two rows in the rear of the switchboard, between the two rows being a concrete trench 2.5 ft. wide by 3 ft. deep, along the sides of which are carried the shaker wires, two of which run from each arc panel to its respective rectifier tubes. This trench is covered with 2-in. matched maple floor. Lead-covered, rubber-insulated cables are used throughout for wiring behind the switchboard and connecting the regulating transformers and rectifiers. The rectifiers are of the General Electric oil-cooled type, two tubes on each circuit, the oil being cooled by circulating water through a submerged coil of 3/8-in. pipe in each oil

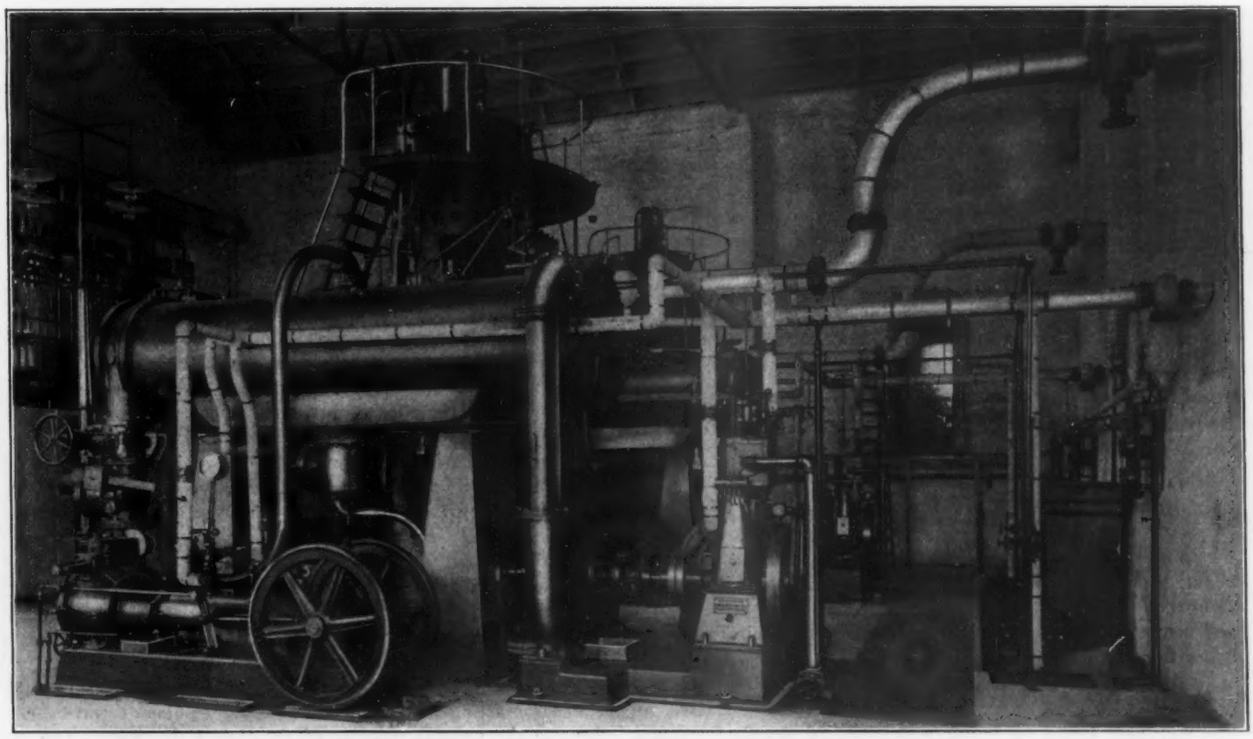


FIG. 5.—VIEW OF CONDENSERS AND OIL FILTERS.

tank. The starting transformers and static discharge apparatus are mounted directly over each set of rectifiers on a 1.5-in. gas-pipe framework, as shown.

The line wires are brought from the station pole to the framework on the building. They pass through the brick wall in ¾-in. porcelain tubes to General Electric horn-type lightning arresters, thence a lead-covered, paper-insulated 8000-volt cable runs down the wall beneath the floor in 2-in. galvanized conduit and up behind the arc panels. The nine arc circuits average at present 46 lamps, there being a total of 420 General Electric magnetite arc lamps on the streets. Along the street-car tracks and in the down-town business district the lamps are mounted on mast-arms with 12 ft. overhang, about 165 lamps being so mounted. In all other places the standard, center suspension is used, placing the lamps approximately 21 ft. above ground. Each lamp is equipped with an absolute cut-out and burns about 175 hours with one trimming.

For the arc circuits, triple-braid No. 8 wire is used, carried on standard, deep-groove double-petticoat insulators. By an agreement with the Home Telephone & Telegraph Company the arc wires are placed on cross-arms, 3 ft. below the telephone wires, on such poles as were available for the city's use. About 900 telephone poles were so used. The arc wires are at least 36 in. apart when placed on telephone poles.

The boiler room and coal yard are lighted with 6-amp Fort Wayne arc lamps and 16-cp incandescent lamps; but tungsten lamps were adopted for general illumination in the turbine room. Three cast-iron ornamental lamp-posts are located in a row between the turbines and switchboard, and spaced about 17 ft. centers. On top of these posts four 1-in. gas-pipe arms extend horizontally 2 ft.; from the ends of these arms are suspended on chains four 100-watt tungsten lamps with 16-in. flat porcelain shades. The wires for these posts run in conduit beneath the floor and in the base of each post is placed a switch and fuse block.

About 50 incandescent lamps are placed around the turbines, condensers, auxiliaries, oil pumps and back of the switchboard, all run in conduit with Condulet fittings, the wiring around the arc transformers and rectifiers being so arranged with flexible connections that any set of the arc-regulating apparatus may be removed without interfering with the lighting of the other equipment.

Mr. Owen Ford, St. Louis, Mo., was consulting engineer and supervising engineer of the plant, with Mr. Fred. L. Shimer as resident engineer in charge of construction. The electrical equipment was furnished and installed by the Fort Wayne Electric Works, whose engineering department made the detailed plans of the arrangement of machinery in the turbine room. The condensers were furnished by the Alberger Condenser Company, and the boilers and all pipe work were installed by the P. K. Engineering Company, St. Louis, Mo.

The Parallel Operation of Direct-Connected Alternators.

By A. E. Buchenberg.

The problem of parallel operation of alternators is fundamentally a question of oscillations of the rotating structure about a state of uniform motion. The actual conditions encountered in any particular case will depend upon the electrical and mechanical characteristics of the alternator and the type of prime mover.

For the purpose of the following discussion all direct-connected alternators may be divided into two general classes, as follows: (1) Those operating with uniform angular velocity. (2) Those operating with irregular angular velocity.

Under the first heading may be included steam turbine and water-wheel driven units, and under the second all alternators driven by reciprocating steam or gas engines.

In the parallel operation of alternators we will have in general to deal with one of the following conditions:

1. Two or more machines with uniform angular velocity working together. 2. Machines with irregular angular velocity operating together. 3. Machines with uniform angular velocity running with machines of irregular angular velocity.

Consider first the condition of two or more machines of uniform angular velocity working together. A "dead" load such as a lighting load has no pronounced tendency to produce oscillations, yet conditions may exist in an electric supply system which will set up such swingings of the field structures, with a resultant phase displacement and interchange of synchronizing current between the generators.

In the operation of rotary converters or synchronous motors we have a condition of pulsating load on the alternators when the load on the motors or rotary converters is changed. Under conditions of constant load the motors or rotary converters will operate with a uniform angular velocity and a constant phase difference whose amount will depend upon the load and field excitation; but a sudden change of load will set up oscillations in the angular velocity about this state of uniform motion. During the time the oscillation is ahead of the position for uniform motion, the relative phase displacement is decreased and the motor or rotary converter is taking less than the proper amount of energy from the supply system. When the oscillation is behind the position for uniform motion, the relative phase displacement is increased, and the machines are taking more than the proper supply of energy. This intermittent or pulsating energy output may react back upon the alternators and cause a variation in their relative angular positions. The resultant condition of the alternator motion may be described as a swinging back and forth of the field structure over the normal condition of uniform angular velocity.

Any alternator possesses within itself a tendency to return to a state of uniform angular velocity when this normal state of motion is disturbed. The intensity of the forces automatically called into play for this purpose depends upon the load conditions and field excitation. The resultant of this action in conjunction with the inertia effect of the rotating parts is usually called the natural "swing" of the alternator.

The synchronizing power of the current surging, by reason of phase displacements, between alternators operating in parallel depends upon the amount of lag of this current due to the self-inductance of the armature windings. A machine with small armature self-inductance, or in other words good inherent voltage regulation, will therefore not have as great synchronizing power as a machine with greater armature self-inductance, other conditions being equal.

The practical problem is to keep the oscillations and consequent pulsations of energy in the circuit within limits as small as possible. This is usually accomplished by the inertia effect of the rotating parts, and the use of "dampers" on the field poles of rotary converters, synchronous motors and alternators. These dampers have no useful function in the normal operation of the machines, and their only service is, as their name implies, to damp out dangerous oscillations.

Turbo-alternators are particularly adapted for parallel operation on a load of rotary converters or synchronous motors on account of their uniform rotative velocity in conjunction with the relatively great inertia or fly-wheel action of the rotating parts.

In the second and third cases given above, the irregular angular velocity of the engines may set up relative phase differences in the alternators, and a periodic interchange of synchronizing currents between them is the result. Under certain conditions successful parallel operation is impossible.

The total irregularity is due to the natural swing of the alternator acting in conjunction with the tendency toward variations in the angular velocity of the engine fly-wheel. The resultant condition of motion is again a swinging back and forth of the alternator field structure over the normal position of constant angular velocity. The periodicity of this oscillation will depend upon the resultant of the inherent synchronizing power of the alternator and the moments of inertia of the moving parts of the unit. A predominating synchronizing power increases the periodicity of the oscillations, while a predom-

inating inertia effect decreases the periodicity. When a balanced condition between the synchronizing power of the alternator and the moments of inertia of the moving parts exists, we have a condition of unstable equilibrium. In such cases the periodic engine speed variation may act in a relation and effect upon the natural swing of the alternator to increase the oscillations, and we have a dangerous resonance effect in the system.

The amplitude of the oscillations is dependent upon the type of engine, number of cylinders, sensitiveness of the engine governor, and the damping effect of the alternator field poles. Decreased amplitude is obtained with a sluggish governor and a large damping effect.

It is usually considered more difficult to operate gas engine-driven alternators in parallel than steam driven units for the following reasons: With a gas engine the time required to make one revolution is variable on account of the unequal impulses of the gas explosions; so that at any instant one unit will be ahead of or behind the others and an interference action is set up. Gas engines are now being built in capacities comparing with the largest steam engines, and their speed regulation perfected to a point where the operation of alternators in parallel by them is a complete success. It is obvious that much heavier fly wheels must be used than with steam engines of equal speed and capacity.

The amount of angular variation permissible in the parallel operation of direct-connected units depends to a great extent upon the character of the load. It has been found advisable in general to fix the maximum allowable phase displacement at five electrical degrees; or in other words, the limitations of the phase displacement by which the machine deviates from a uniform rotation in any one revolution shall not exceed two and one half electrical degrees. The angular displacement of the rotating field structure corresponding to a phase displacement of two and one half electrical degrees will be equal to two and one half divided by one half the number of field poles. It follows directly from the above that a less angular variation is allowable for slow speeds and a large number of poles than for higher speeds.

Engine governor adjustments and the use of heavy fly-wheels are the means of overcoming the difficulties attendant upon the parallel operation of direct-connected units. Heavy fly-wheels alone will not answer the purpose, for reasons as follows: The interchange of synchronizing currents between the machines always tends to accelerate the lagging machine and retard the leading one. If extremely heavy fly-wheels are used to reduce the engine speed variations we make it more difficult for the synchronizing currents to perform their functions rapidly on account of the great inertia of the rotating parts. In addition to this the sensitiveness of the engine governor to rapid responses for changes in load becomes less for the same reason. On the other hand, the fly-wheel must be heavy enough to keep the amplitude of the variations within limits, and to prevent an excessive speed variation during the interval required by the governor in making the proper adjustment for changes in load.

The adjustment of the engine governor has a decided effect upon the parallel operation of alternators, and different forms of dash pots are in use to effect a greater or less retardation of the governor. This method is very satisfactory up to a point where the engine speed control begins to be seriously affected. The most effective form of dash-pot is one which affords a strong damping action to rapid pulsations of the governor, and at the same time offers but a slight opposition to a sustained tendency to operate in answer to a change in load.

Engines intended to drive alternators coupled in parallel should be equipped with governors which are capable of being adjusted for slight changes in speed while the engine is running. This enables the load to be conveniently and accurately divided among the generators.

The conditions necessary for parallel operation may be finally summed up as follows:

1. The machines must be in phase. 2. The machines must be in synchronism. 3. The voltages must be approximately equal. 4. The speed of the prime movers must vary alike under changes of load, or provision must be made for speed adjustments while the machines are running. 5. The oscillations set up by a varying load must be of small amplitude and rapidly damped out. 6. The forced oscillations set up by the prime mover must be of small amplitude.

Star and Delta Transformer Interconnections.

BY W. T. RYAN.

The choice of star or delta connections for the transformers used in three-phase systems still remains a subject for discussion and consideration when selecting apparatus for new installations.

Where only a single transformation is made, one of the following four combinations is usually selected: Primary coils connected star, secondary coils star; primary coils connected delta, secondary coils delta; primary coils connected star, secondary coils delta; primary coils connected delta, secondary star. In addition there are the two-phase to three-phase "T,"

FIG. 1.—DELTA-DELTA INTERCONNECTION.

the three-phase to three-phase "T" and the three-phase to three-phase "V," which are sometimes used at either end of the system.

Each combination has its advantages and disadvantages. The writer is of the opinion that the delta-delta system has much in its favor for the majority of installations.

The possibility of abnormal voltage strains being produced by an open-circuit, a short-circuit or a "ground," is a minimum if a straight delta-delta system of connections is used; the possible increase is less for a star-star system than it is if a part star, part delta system is used.

The results of the following tests made with three specially built transformers whose ratio of transformation is one-to-one

FIG. 2.—OPEN-DELTA INTERCONNECTION.

indicate that abnormal strains may easily be produced in a mixed system.

When the e.m.fs. of the system shown in Fig. 1 are balanced the strain to ground on any line is only $\frac{1}{\sqrt{3}} = 0.58$ of the line voltage. The maximum strain to ground in case of a ground on any line wire is the full line potential. Any one transformer may be cut out leaving the other two connected in V, and they will deliver volt-amperes up to their full rating, that is, 58 per cent of the rating of the bank in the balanced load, or 66 per cent of the full rating if the load is properly unbalanced.

In a three-phase to three-phase V-connected system the line voltages become unbalanced, as shown in Fig. 3, if the leads of the secondary coil of one of the transformers are reversed, thus making the strain to ground 73 per cent greater than the line voltage.

In the star-delta system a short-circuit on the primary of

FIG. 3.—REVERSED OPEN-DELTA INTERCONNECTION.

one transformer produces the e.m.fs. shown in Fig. 5, and also causes abnormal local circulating currents.

In the star-delta system, with the delta open at one point and a short-circuit on one transformer (Fig. 6) the voltage on the two remaining transformers will be increased by 73 per cent, and between two of the leads there will be *three times normal*

voltage. With such a system on an 80,000-volt line, 240,000 volts may be obtained in case a transformer is short-circuited.

Fig. 7 shows the voltages when the primary of one of the raising transformers is short-circuited and the secondary is disconnected. On the lowering delta three times normal voltage is impressed on one of the transformers and 1.73 times normal on

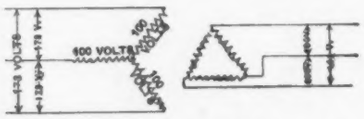


FIG. 4.—STAR-DELTA, NORMAL SYSTEM.

the other two. Between two of the leads of the delivery circuits there is an e.m.f. of normal value, while between each of these leads and the other one 2.69 times normal voltage exists.

A very large number of combinations of raising and lowering transformers may be obtained, nearly all of which are subject to severe voltage strains from accidental or unusual connections. While it may be said that these conditions are only accidental or unusual, yet it is the unusual and accidental which must be guarded against if trouble is to be avoided.

The delta-delta interconnection has a number of operating ad-

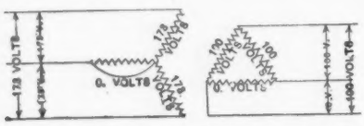


FIG. 5.—STAR-DELTA SYSTEM, ABNORMAL.

vantages, the principal ones of which are that a transformer may be cut in and out of service without causing any inconvenience or disturbance to the system, while the possibility of abnormal strains being produced by unusual conditions is a minimum.

The usual reason for installing a mixed system is that it often seems desirable to put in transformers connected in delta and afterward to raise the voltage by changing over to star connections. Equally good results can easily be accomplished by putting a double winding on the transformers, operating the coils at first in parallel and later in series.

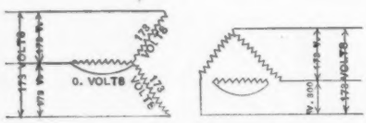


FIG. 6.—STAR-DELTA SYSTEM, NORMAL.

The principal advantage of a star-connected system is that it furnishes a neutral point which may be grounded. The writer is of the opinion that the present tendency to ground everything on a high-tension system which it is possible to connect to ground is more a fad of the time than anything else. A proper ground connection is very difficult to obtain and with a grounded neutral one accidental connection of a wire to ground will disable a part, or the whole, of a system.

In some cases specific conditions may make it desirable to

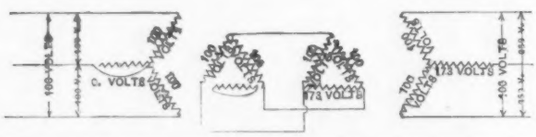


FIG. 7.—STAR-DELTA, DELTA-STAR DOUBLE INTERCONNECTION, ABNORMAL.

ground the neutral, thus influencing the selection of a star-connected system. When the system is extensive and the importance of uninterrupted service is great, thus making it desirable to avoid any possibility of abnormal rises of potential from any cause, a grounded neutral should not be employed unless it is demanded on the score of safety to life.

Contracts Relieving Employers from Negligence.

By John E. Brady.

It is by no means uncommon for an employer of labor, engaged in work of a dangerous or hazardous character, to have a stipulation written into the contracts of employment made with the men whom he engages, relieving him of liability for negligence which results in injury to the workmen. And the courts have been called upon many times to determine the validity of such provisions. Contracts of this kind are a favorite with railroads, but they appear to have been frequently adopted as a precautionary measure in other industries.

One of the most recent cases in which such an agreement was introduced in defense of an action by an employee to recover damages from his employer for injuries received in the course of his employment is that of Johnston v. Fargo, a decision of the New York Court of Appeals, reported in 184 N. Y., 379. The plaintiff in that case was in the employ of an express company, and his injuries were occasioned by his falling with an elevator in a barn belonging to the company, while the elevator was being used for the purpose of carrying down some vehicles. The complaint charged that the elevator was in a defective condition and that the occurrence was due to the fault or negligence of the company. The ground of defense upon which the company stood was the contract of employment which the plaintiff signed at the time of his entry into the service of the company. By the contract the plaintiff agreed to assume all risks of accident or injury, whether occasioned by the negligence of the company, or its officers or agents, and, in event of injury, to execute a release under seal of all claims for damage. The question as to the soundness of the defense was one upon which the Court of Appeals had not previously pronounced itself. The court, conceding that the question was a debatable one, decided in accordance with the great weight of authority, which holds these agreements void and unenforceable.

The ground on which such contracts are held invalid is that they violate public policy. If it were the interest of the employed only that would be affected by such contracts, it would be difficult to defend upon sound reasoning the denial of the right to enter into them. But the theory of their invalidity is in the importance to the State that there shall be no relaxation of the rule of law which imposes the duty of care on the part of the employer toward the employed. The State is interested in the conservation of the lives and of the healthful vigor of its citizens, and if employers would contract away their responsibility at common law, it would tend to encourage on their part laxity of conduct in, if not indifference to, the maintenance of proper and reasonable safeguards to human life and limb. The rule of responsibility at common law is as just as it is strict, and the interest of the State in its maintenance must be assumed; for its policy has, in recent years, been evidenced in the progressive enactment of many laws which regulate the employment of children and the hours of work, and impose strict conditions with reference to the safety and healthfulness of the surroundings of the employed, in the factory and in the shop.

The employer and the employed theoretically deal with each other upon equal terms; but, practically, that is not always the case. The artisan or workman may be driven by need, or he may be ignorant or of improvident character. It is, therefore, for the interest of the community that there should be no encouragement for any relaxation on the employer's part in his duty of reasonable care for the safety of his employees. That freedom of contract may be said to be affected by the denial of the right to make such agreements is met by the answer that the restriction is but a salutary one, which organized society exacts for the surer protection of its members. While it is true that the individual may be the one who directly is interested in the making of such a contract, indirectly the State, being concerned for

the welfare of all its members, is interested in the maintenance of the rule of liability and in its enforcement by the courts.

In Purdy v. the Rome, Watertown & Ogdensburg Railroad Company, 52 Hun. (N. Y.) 267, the plaintiff, an employee of defendant, was injured while in the discharge of his duties through the alleged negligence of defendant. In an action to recover damages, defendant gave in evidence a paper signed by plaintiff by the terms of which, in consideration of his employment, he agreed that the company should in no case be liable for any damage to him by reason of its negligence. It appeared that the plaintiff was at the time of the execution of the instrument, and had been for some years prior thereto, in defendant's employ. His original employment was a general one and for no particular time. He signed the release without compulsion, and continued thereafter in the same employment, and for the same compensation as before, no new employment was tendered to or accepted by him, and there was no promise that the employment he was then engaged in should be continued, nor was its execution made a condition of continued employment, and no consideration was paid therefor. It was held that the instrument was void for want of consideration, and, therefore, it did not become necessary for the court to pass on the question as to whether the agreement would have been valid had the defendant given a valid consideration in return for the release. This question has now been settled definitely in the State of New York by the decision in Johnston v. Fargo, referred to above.

In Gulf, C. & S. F. Railway Company v. Darby, Court of Civil Appeals of Texas, 67 S. W., 446, the plaintiff was in employ of defendant as a switchman and was injured by coming in contact with the roof of a building projecting dangerously near the line of the railroad. His crew had been sent to the storeroom track to take out a caboose. It being dark, the men lighted their lamps. The caboose was coupled onto the train; the plaintiff mounted it by a side ladder and was walking back in the direction in which the cars were moving when he was struck by the projecting roof of an oil house between which and the cupola of the caboose he was caught and injured.

It was held that a stipulation in his application for employment that he understood that at some points on the line there were various buildings and structures near the tracks, which might be dangerous, and that he must inform himself of the location of such obstructions and use due care to avoid injury thereby, was void as against public policy in so far as it attempted to relieve the company from its duty of providing a reasonably safe track and of warning the employee of dangerous obstructions near the track.

The case of Tarbell v. Rutland Railroad Company, Vermont 51 Atl., 6, was an action against a railroad company for its negligence in permitting a car, loaded with lumber, to stand on a sidetrack in such proximity to the main track that one of the defendant's brakemen, while descending a ladder on the outside of a car running on the main track, was knocked from the car and so injured that he died. The action was brought by the plaintiff as administrator of the deceased brakeman. The company's defense was that, at the time of the hiring of the brakeman, the plaintiff, acting as his nearest kin, entered into a contract with the company purporting to release it from all liability for damage that might accrue to him by reason of the company's negligence during the term of the employment. The general rule of law was stated to be that whatever tends to injustice or oppression, restraint of liberty, and natural or legal right, or to the obstruction of justice, or to the violation of a statute, and whatever is against good morals, whenever made the subject of a contract, is against public policy and void. "Contracts of the kind in question," said the court, "are clearly against public policy, and invalid, for the reason that they tend to promote negligence on the part of corporations in respect to the personal safety of their employees."

In another instance, the plaintiff was a brakeman on a freight train of the Lake Shore & Michigan Southern Railway Company. While in the line of his duty he was injured, without his fault, and by the negligence of the conductor of the train. The company set up as a defense that the contract which the brakeman signed at the time he entered the service of the company contained the following stipulation: "That while the company will be responsible to me for the discharge of all its duties and obligations to me, and for any fault or neglect of its own or its board of directors or general officers, which are the proximate cause of injury, yet it will not be responsible to me for the consequences of my own fault or neglect, or that of any other employees of the company, whether they or either of them are superior to me in authority as conductor, or foreman, or otherwise, or not." The Ohio court, before which this case was brought, decided against the defendant on the ground that the contract contravened policy. Lake Shore & Michigan Southern Railway Company v. Spangler, 44 Ohio St. 471, N. E., 467.

Though the weight of authority is against the right of an employer to escape liability for negligence by making a contract to that effect, there is respectable authority in support of the view that such contracts are valid. Contracts of this character have been upheld in England and by the courts of the State of Georgia. A complete collection of these decisions can be found in 6 Amer. & Eng. Annotated Cases, Page 7.

In Western, etc., Railroad Company v. Bishop, 50 Ga., 465, where an employee of a railroad company, by a written contract made in consideration of employment, agreed to "take upon himself all risks connected with or incident to his position on the road," and that he would "in no case hold the company liable for any injury or damage he may sustain in his person or otherwise, by what are called accidents or collisions, on the trains or road, or which may result from the negligence, carelessness or misconduct of himself or another employee or person connected with said road, or in the service of said company," it was held that such contract was valid and binding in so far as it did not waive any criminal neglect of the company or its principal officers; but that any attempts to waive criminal negligence would be contrary to good morals and public policy. That case was followed and applied in Western, etc., Railroad Company v. Strong, 52 Ga., 461.

Subsequently, however, a statute was passed (Penal Code, Sec. 115) which provided in effect that the negligence of any railroad employee, by either omission or commission, resulting in the injury, but not in the death, of another should be deemed criminal negligence; and in Cook v. Western, etc., Railroad Company, 72 Ga., 48, that statute was held to render void a contract by a railroad employee waiving the company's liability for negligence and misconduct, and to authorize a recovery, by the widow of such employee, of damages for his death caused by such negligence. But in Southern Railroad Company, 116 Ga., 147, 42 S. E. Rep., 391, a contract between a railroad company and the father of an infant servant, exempting the company from liability for damages for any injury sustained by the infant while in its employ, was held to bar an action by the father for loss sustained by him by reason of the infant's death through the negligence of the company; the court disapproving and refusing to follow Cook v. Western, etc., Railroad Company, 72 Ga., 48, on the ground that the two justices (less than the full bench) by whom that case had been decided had entirely overlooked the fact that the statute exempted from the operation of its provisions all cases in which death was caused, thus leaving negligence resulting in death to be governed by the rule laid down in Western, etc., Railroad Company v. Bishop, 50 Ga., 465.

In Griffiths v. Dudley, an English case, 9 Q. B. Div., 357, where an agreement relieving an employer from liability for negligence, was held to be quite consistent with public policy, the view of the English court, as expressed by Justice Field, was that "the interest of the employed only would be affected" and not that of "all society," and "that workmen, as a rule, were perfectly competent to make reasonable bargains for themselves." It is to be observed, however, with respect to the situation in England that subsequently, in 1897, an Act of Parliament was passed, entitled "The Workingmen's Compensation Act." which, in effect, declares the public policy of the state. By that act, in reality, though not in form, the right of the workingman to contract away his right to recover compen-

sation from his employer is nullified; inasmuch as such a contract is only valid when, as between employer and employed, there exists a general scheme for compensation, which secures to the working man benefits as great as those he would derive from a proceeding under the compensation acts.

In many jurisdictions, for instance in Massachusetts, Missouri, Minnesota and North Carolina, statutory or constitutional provisions have been enacted declaring contracts attempting to work an exemption from liability for negligence void. Some of the provisions apply only to railroad companies, while others are given general application.

Lessons from Some Recent Electrical Troubles.

The prevention of accidents and fires caused by improper operation of electrical equipment is a matter of continual importance. Progress in electrical design and mechanical construction will do much to prevent the occurrence of trouble, but careful inspection and alert appreciation of the possibilities of disaster are essential to the safety of operating men in a way which no question of design and initial installation can parallel. A number of unrelated accidents due to faulty operation of electrical distribution circuits may be cited in the hope that they will prove suggestive in a general way to operating departments of public service corporations.

In a large municipality one of the most important matters when a new work is being constructed is the prevention of any contact of derrick guy wires with overhead circuits. Troubles of this kind are liable to be far-reaching, and disastrous fires have resulted from the contact of a guy wire with an adjacent trolley wire. Not long ago a fire occurred from this cause in a storage warehouse of excellent construction which was being enlarged. The derrick guy wire happened, as usual, to be grounded, and electricity entered the building and caused considerable damage before the trouble could be remedied. It is desirable to use great care in the setting of arc lamp posts to avoid close proximity to other grounded structures or fixtures, such as old gas brackets, metal awnings and guy wires. Cases have occurred where metal awnings have been erected around street lamp posts already in position, at such a height that a person could easily stand upon the awning and touch the wires connected to the lamp, and accidental contacts of this kind have been made with disastrous results. In many cities insufficient data exist as to the location of underground cable structures, and whenever new construction is undertaken it is found to be difficult to plan its proper disposition. Exceptional care is necessary in the examination of the underground plans of various public service corporations, not only on account of the probably crowded condition of the subsurfaces, but due to the fact that much of the data being taken from numerous separate plans made by many different persons, the pipes, conduits, etc., are sometimes found to be plotted in other than their correct locations, and in some cases whole lines of conduits or pipes are entirely omitted. It should be required of the municipal authorities who approve locations of conduits that they maintain correct maps of all underground structures in the territory over which they have jurisdiction, in order that bad constructions and injuries to existing installations may be avoided.

The careless use of tools around power plants is responsible for a good deal of trouble. In one substation a loss of $10,374 was occasioned in this way, and the equipment was temporarily shut down while supplying energy to an important portion of the city service in the heart of the business district. The cause of the fire was a short circuit between two cables of a high potential circuit, made by a screwdriver in the hands of a workman. In another case an employee of a firm of constructing engineers was at work in a large plant attempting to remove a portion of a lead cable which was "live" at the time. The lead sheath had been cut, and an effort was being made to raise the edge of the sheath with a screwdriver. The point of the driver pierced the insulation and the blade made simultaneous contact with the live conductor and the lead sheath of the cable. No fire occurred, but the workman received burns about the face and hands. Another case of severe skin burn occurred while an employee was taking measurements on the rear of a low-tension substation switchboard. He produced a short circuit by accidentally bringing the edge of a portable lamp which he was using into simultaneous contact with live parts of opposite polarity on the board. In still another substation an employee of a contractor was severely burned about the face as a result of a short circuit while he was engaged on switchboard work. The accident was caused by a wire which he was trying to pass between a set of battery busbars and the ceiling making contact between one of the busbars and a grounded iron hanger support of the former.

A power-station accident which had a fatal termination occurred during the test of the field circuit of a 2700-kw generator. Two employees of a contracting engineer were at the time standing on an iron flooring and leaning against the wheel used to regulate the position of the brushes on the commutator. The wheel was supported by a metal piece attached to the field frame. The men were awaiting the results of a test on the field coils, 550 volts being applied for the purpose. When the e.m.f. was thrown on, a slight cry was given by the men, who fell to the floor and were both found to be dead upon examination. The accident emphasized the extreme importance of keeping out of contact with electrical machinery during the application of even moderate voltages. It is unsafe to assume that the conditions are as they should be, and in cases where the insulation is defective the variety of troubles which may occur on accidental contact with excessive voltages is too large to treat with impunity.

Carelessness in adjusting generators has been the cause of many accidents, and a typical case is that of a substation operator who, while attempting to stop the rocking of the brushes of an arc machine, reached with his left-hand to shut off the automatic control, while with his right-hand he reached for a brush holder. In doing this his right fore-arm came in contact with the brushes of the machine and as a result he received a shock which knocked him down and gave him severe burns on the arm that came in contact with the brushes of the machine. In this case the operator was fortunate to escape with his life.

The importance of allowing plenty of space between all switching apparatus and surrounding parts of power-plant buildings was illustrated by a small fire which occurred in a substation through a short circuit in an oil switch. The latter took fire and the flames immediately spread to the ceiling, which was sheathed with wood. It cannot be too strongly emphasized that spacings of apparatus, cables and bare terminals that seem adequate during times when everything is operating satisfactorily are often nowhere nearly wide enough to hold back the heavy arcs forming in serious short circuits. Switch barriers for even moderate e.m.fs. of from 2300 volts to 6900 volts need to be ample in all dimensions for successful and continuous operation. The loss in the case cited was less than $200, but the trouble in a substation with less favorable means of putting out the fire might well have been serious.

A case of fire in a remote portion of a power plant occurred in the motor compartment at the top of a coal pocket. The motor was used to operate the coal conveyor, and although the damage was confined to the motor, the wiring and the surrounding woodwork, yet it emphasized the importance of frequent inspection of motor conditions in isolated portions of large plants where large amounts of combustible matter are stored. Coal hoist or conveyor motors are rarely installed in localities favorable to cleanliness, and the constant influx of carbon dust, with the possible neglect of bearings and wiring, remote control switches, etc., may readily bring about conditions leading to a fire. Incidentally, if the conveyor equipment is not properly maintained, with special reference to the lubrication of the bucket and idler bearings, the resulting stiffness of operation may overload the motor so much that burnout is caused. If the motor bearings are allowed to run dry or over-

heat excessively, the shaft may stick and cause the burning out of the armature, with consequent danger of fire.

Overhead wiring must at all times be protected from accidental contacts with other equipment or poor installation for temporary or regular service. When carpentry work is being done on the premises of an electrical installation the greatest care is necessary to insure that the stagings and other temporary falsework are not built or moved into locations where they come into contact with electric wires. This is an elementary precaution, but it needs reiteration. In one recent case the occupant cut "live" electric lighting wires flush with the floor and left the ends untaped. Later the floor was washed, and arcing and flashing occurred at the ends of the wires to such an extent that the fire department was called in. In another instance a short circuit occurred on an electric lighting circuit, the insulation of which was injured by a weight acting as a counterweight for a door of the sliding type. The damage was slight, but the possibilities of trouble of a serious nature were all present. A case of fire occurring from a wiring circuit run in molding on a damp brick wall emphasized the importance of using conduit wiring in wet locations.

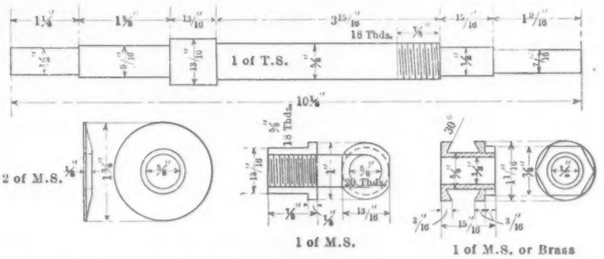
The need of inspection of overhead lines with regard to the attachment of wires to their respective insulators was illustrated by a fire on the under side of a bridge, caused by the grounding of a series arc wire which had become detached from its insulator in a heavy rainstorm. A case occurred in a new building where a whip hoist was being used for transporting materials. The metal cable of the hoist was permitted to come into contact with a street railway trolley line. The metal cable was in contact with the building and as a result the current passed from the trolley wire through the cable, ironwork of the building, and a gas pipe in the basement of a nearby structure, burning a hole in the pipe, igniting the gas and causing a small fire. The effects of a contact of this kind are often remote from the immediate source of the short circuit, and are consequently all the more difficult to detect at once and fight during the initial period of the fire.

Design of a One-Sixth Horse-Power Motor.

By F. C. Mason.

The motor illustrated herewith was designed to operate a window-display machine. One of the requirements was that the machine should be nickel plated and inasmuch as a motor could not be found to meet the requirements one had to be designed especially for the work. It is an easy matter to machine the frame so that it can be readily polished and nickel plated, and when finished this way the motor is very handsome in appearance. The machine runs quietly and sparklessly and is quite powerful for its size.

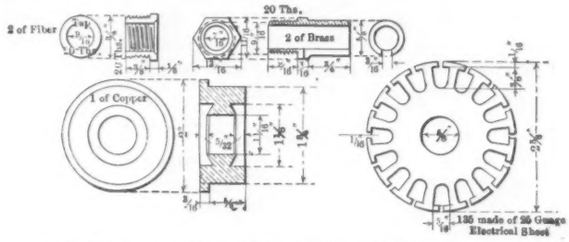
Fig. 1 represents a section through the center of the field structure looking down from the top. Fig. 2 shows an end elevation half in section, so as to show one brush holder in place.



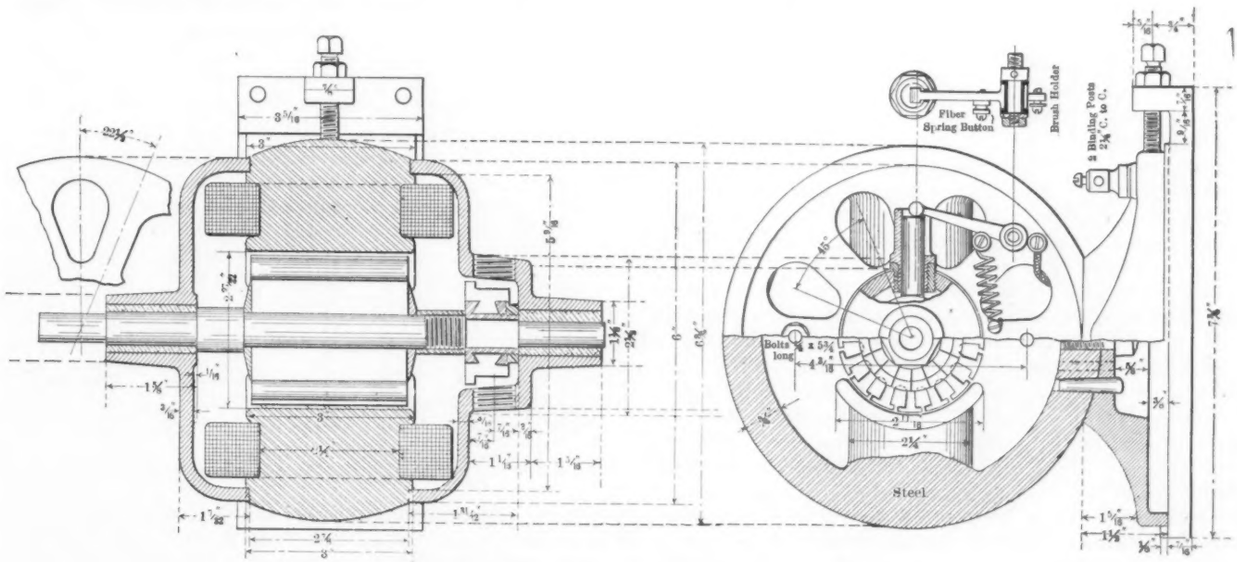
FIGS. 3 TO 6.—DETAILS OF SHAFT AND OTHER PARTS.

The only novel feature of the motor besides its design is the excellence of the brush holder; as is well known, the weak feature on all small motors is the cheapness of the brush-holder arrangement.

The field structure is made of a motor-steel casting (there is a special mixture of steel made for generator and motor castings). The bonnets are made of cast iron. Both the field structure and bonnets should be bored and finished on a mandrel so as to assure perfect alignment of the armature bearings as well as to have the armature centrally located between the pole pieces. In the first issue of August, 1908, the writer described the process of making a 1-hp motor, and the same method of building the armature as described in that article may be applied to the present one. If it is found impossible to make the armature disk slots as shown in the illustration, the slots may be milled, in which case a cutter ¼ in. wide should



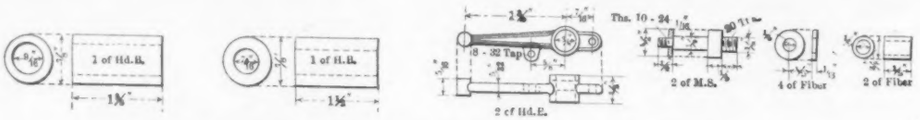
FIGS. 7 TO 10.—COMMUTATOR AND ARMATURE DETAILS.



FIGS. 1 AND 2.—SECTIONAL VIEW AND END ELEVATION OF MOTOR.

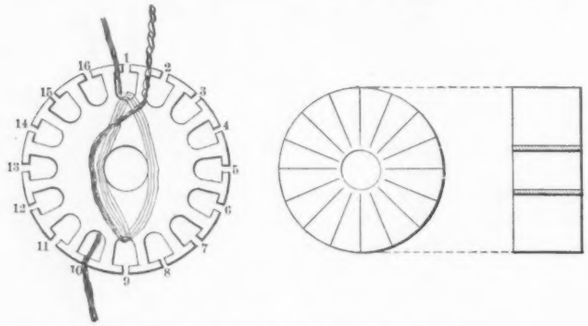
be employed, the depth of the cut being ⅜ in. The plane slot will not result in quite as good an armature as the one shown, but will suffice. If a plane slot is used it will be necessary to put binding bands around the armature after the winding has been completed. With the type of slot shown this will not be necessary, the winding being held in place by a piece of hard fiber 1/16 in. thick by ⅛ in. wide.

Figs. 3 to 16, inclusive, show the details of the small parts,



FIGS. 11 TO 16.—DETAILS OF SMALLER PARTS OF MOTOR.

and the number of each, as well as the material from which each is to be made. A view of an assembled brush holder is shown above the binding post in Fig. 2. Fig. 10 shows a brush holder which is insulated from the bonnet by a hard-fiber bushing, shown in Fig. 9. The holder and bushing are shown screwed to each other in Fig. 2, but this method of assembling may be dispensed with and a light driving fit substituted. The latter is easier to make and answers the purpose just as well. Fig. 13 shows two views of the arm that forces the brush against the commutator. This arm swings on a stud, shown in Fig. 14, the stud being screwed into the bonnet. The arm must be insulated from the stud by fiber washers and bushings, shown in Figs. 15 and 16. The two arms are drawn together by a helical spring. The latter is insulated from the arm by the fiber but-



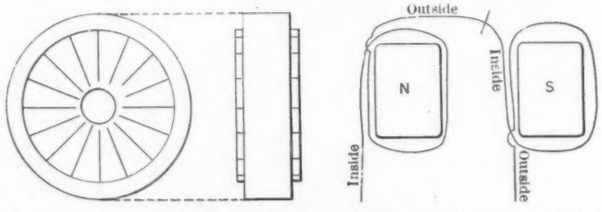
FIGS. 17 AND 18.—WINDING DIAGRAM AND COMMUTATOR.

ton shown in the assembled brush-holder drawing. Fig. 5 shows a nut for tightening the armature disks together on the shaft. The drawing shows a two-sided head on the nut for the purpose of tightening the nut with a wrench and when the disks are jammed home this head may be turned off.

Small commutators are very hard to make if turned out in the usual way. The writer has a process of his own which is novel and efficient. A forging is made of pure copper to the required size; in this case 2 1/16 in. x ⅞ in. The forging should be placed in a chuck and a ½-in. hole bored in the center. It should then be placed on the mandrel and rough turned. It should next be placed in a universal milling machine and the slots cut (using the index head for spacing). With a slotting cutter, 1/32 in. thick, the slots should be cut to within 1/32 in. of the mandrel, as shown in Fig. 18. It will be necessary to employ a sharp cutter and the work must be done in three cuts, as copper is hard to saw and cannot be forced. Lard oil should be used on the cutter during the operation. After the slots have been sawed they should be washed thoroughly in gasoline and all fins or sharp edges filed off. Enough pieces of hard mica board should be cut to fill the slots. A micrometer should be used on the mica so that pieces too thick will not be employed. Thick pieces may be scaled off until the required thinness is obtained. In placing the mica in the slots each piece should be shellacked as put in, and when all are fitted the commutator should be baked until the shellac is hard. After this operation has been completed, the commutator should be placed on a mandrel, the projecting mica turned off, and a ring fitted around the commutator, as shown in Fig. 19. The commutator is then ready to be finished inside to the specifications shown in Fig. 7. In assembling, the bushing shown in Fig. 6 should be used with semi-flexible micanite insulation between it and the copper as described in the article published in the August number. The binding ring may then be removed and the outside turned down to size. This method will result in an absolutely perfect commutator. Slots 1/32 in. thick by ⅛ in. deep should be sawed in each segment projection for the armature connections.

The armature should be wound with No. 27 double-covered silk magnet wire; 120 turns in each slot when finished. Sixty layers should be wound around the first time and 60 layers in the final winding. The slots, ends of armature, and the shaft must be insulated with fiber and flexible micanite. Fiber 1/64 in. thick should be used for the slots and the flexible micanite should be used for the ends and the shaft. Fig. 17 gives a diagram of the winding, showing one coil in and the start of the next coil. The winding should be started in slot No. 1 and 30 turns should be wound in slots Nos. 1 and 9 on each side of the shaft. The terminal should be brought up to slot No. 2, a loop made, and 60 more turns wound from slot No. 2 to slot No. 10. This should be repeated until twice around and the terminal should be connected to the starting terminal slot No. 1. Two leads, or a double wire, will be left protruding from each slot. With the silk-covered magnet wire it is not necessary to use linen between each layer of wire as in the case of the 1-hp machine described in the previous article. In connecting the leads to the commutator they should be brought around one-quarter turn, or, in other words, if slot No. 1 of the commutator and slot No. 1 of the armature were parallel, the lead from slot No. 1 in the armature should be connected to slot No. 5 in the commutator.

The field coils are made up of 2000 turns of No. 30 single-covered cotton magnet wire. For this purpose a wooden winding form, as shown in Fig. 15 of the previous article, should be employed. As the pole pieces are 2½ in. in diameter and the shoes are somewhat larger, the winding form must be large enough so that the coil can be slipped over the pole shoes, which would be 2½ in. x 3 in. x 1 in. wide. After the winding has been completed a piece of lamp cord should be soldered on for the terminals, the soldered joint taped and then the whole coil covered with two layers of cotton tape. The completed coil should then be shellacked or painted with insulating varnish. The two field coils should be held in place by two pins drilled in and protruding from the pole pieces; a small piece of



FIGS. 19 AND 20.—COMMUTATOR RING AND FIELD WINDING DIAGRAM.

fiber being inserted between the pin and the coil for protection. Fig. 20 shows a method of connecting the coils and it is imperative that they should be connected as indicated. The base shown in Fig. 2 has two binding posts, only one of which is shown. These connecting posts are insulated from the base by fiber washers and bushings. As the motor is small it does not require the usual three-point connections, and the field terminals are bridged directly into the armature leads. The

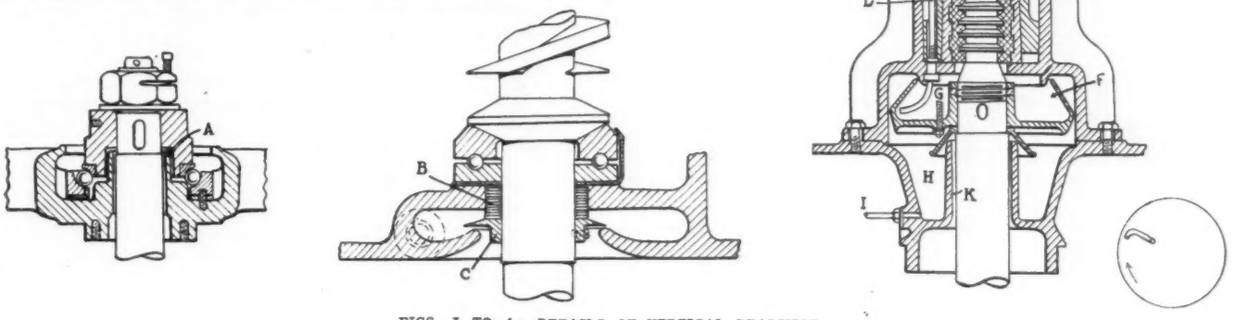
base is recessed to contain the two armature leads as well as the two field coil terminals, one of each running to each binding post. The field-coil terminals pass through the magnet frame and base, a ⅜-in. hole through both being provided for that purpose.

The motor can be started from any lamp socket without the use of a starting box, and the speed ranges from 1500 to 1600 r.p.m. If necessary, a cast-iron field structure may be used in building the motor, in which case the following data obtain: Armature, 200 turns to slot of No. 29 double-covered silk wire; field coils, 2000 turns of No. 33 double-covered cotton wire; speed, 1800 to 2000 r.p.m.

Lubrication of Vertical Bearings.

By J. NIKONOW.

While easily accomplished with the horizontal bearings, proper and automatic lubrication becomes difficult with vertical bearings. In the latter case there are two problems to solve:



FIGS. 1 TO 4.—DETAILS OF VERTICAL BEARINGS.

1. To cause the oil to circulate automatically from the bottom of the bearing to the top, or, if possible, to keep the bearing immersed completely in oil. 2. To prevent the oil from creeping and escaping along the shaft.

Fig. 1 represents a very common type of ball bearing on the top of the journal. Such bearings have a great advantage in that they can be easily removed for repair or inspection and also can be kept well filled with oil. The wall *A*, which prevents the oil from escaping, is very often made of smaller size, so as to allow the overflow oil to pass along the journal through special ducts to the bottom bearing. Some manufacturers have the same construction for step thrust bearings, although in this case friction is largely increased, as the diameter of the bearing becomes considerably larger than that of the shaft.

Fig. 2 represents a thrust bearing for a small high-speed hoist. The ball bearing is located in the casing with the worm gear, hermetically sealed and filled with oil. The leather packing *B* and the oil thrower *C* prevent the oil from escaping to the commutator. The motor is fitted with grease cups, so that, being once filled, the hoist can work equally in horizontal or vertical positions.

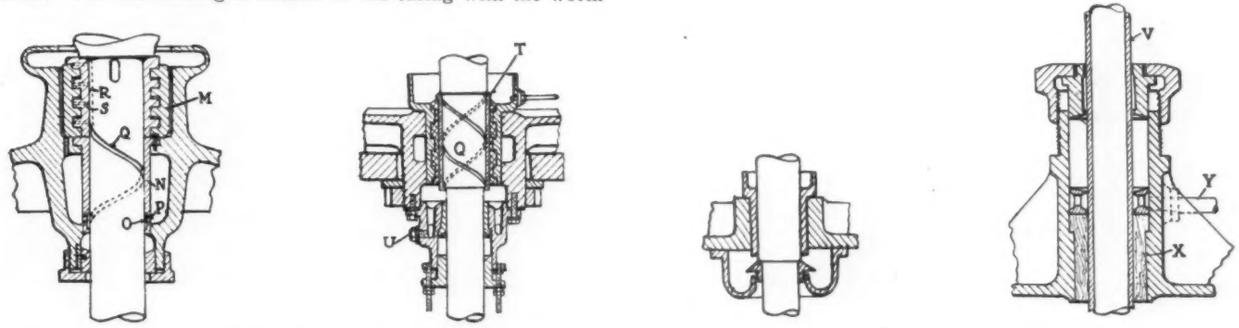
In Fig. 3 is shown a very good step bearing for a large motor running at 650 r.p.m. The bearing itself is made in two halves, lined with the white metal. It has a conical outside surface, fitting that of a bushing, *D*. Two screws, *E*, are used to tighten the bearing and two others to release it. Oil flows along the shaft and bearing into the cup *F*; this cup can take only a certain amount of oil, the excess flowing through the pipe *G* into the well *H*, from which it may be withdrawn or fed into the bottom bearing through the pipe *I*. The wall *K* protects the armature from the oil.

In assembling the lower end of the feed pipe, *L* is turned toward the bearing, until the latter is fitted, when it is turned outward until it comes as near as possible to the wall of the cup *F*. The oil rotates in the cup *F* and as the bottom of the pipe *L* is directed toward the rotation (see Fig. 4) the oil is fed upward to the upper part of the bearing with a head of about ¼-in. when the speed and dimensions are properly fixed.

The construction shown in Fig. 5 is a step bearing located, somewhat unusually, at the bottom of a motor. It consists of the bronze bearing bushing *M* and a guide bronze bushing *N*, with a circular channel *O* and holes *P*. On the shaft is cut a spiral groove *Q*, which terminates in the channel *O* at the bottom, and in the vertical groove *R* at the top. The oil, under the velocity pressure, flows up the groove and then, by centrifugal force, passes through the holes *S* to the working surfaces of the step bearing. This bearing has proved quite satisfactory.

A somewhat better arrangement is shown in Fig. 6, which represents a guide bearing. The automatic lubrication is accomplished by means of two spiral grooves *Q*, shown, as in the previous example, for counter clockwise rotation. On the shaft is pressed a hard steel bushing *T*, which is machined afterward with the shaft.

A very simple and common construction is shown in Fig. 7. No packing is required in this case, but the bearing must be constantly fed with oil from a top bearing or through a special pipe. Large vertical motors are usually supplied with special pressure pumps to pump the oil from the bottom to the top



FIGS. 5, 6, 7 AND 8.—LUBRICATING ARRANGEMENTS FOR VARIOUS TYPES OF VERTICAL BEARINGS.

bearing, from which it flows back to the bottom through some special channels in the spider or shaft.

When the bearing is completely immersed in the water, as is usually the case with centrifugal pumps and turbines, then the best lubrication is obtained from the water itself, the guide bearing being made of a special sort of the hardwood. Fig. 8 shows a bearing of a small Rateau pump with the wooden bearing bushing *X*. The pipe *Y* connects the space above the bushing (packing) with the water in the pump under pressure, as the wooden bearing cannot work when dry. A bronze sleeve *V* is fitted on the shaft to prevent it from rusting.

Forced Draft for Steam Boilers.—II.

By W. H. Wakeman.

In the previous article various methods of connecting fans for boiler draft purposes were described. There are many conduit arrangements for delivering the air from the fan to the

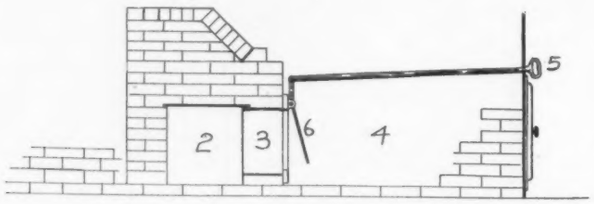


FIG. 1.—DAMPER ARRANGEMENT FOR FORCED DRAFT SYSTEM.

ash pit, a suitably arranged damper being provided for controlling the amount of air admitted from the duct. In Fig. 1 the main conduit 2 is extended through all of the bridge walls, with an outlet 3 for each ash pit 4. By means of the handle 5 the damper 6 is partly opened, thrown wide open or tightly closed by the fireman from the boiler fronts. Fig. 2 shows a somewhat similar device except that the main conduit 2 is a pipe laid especially for the purpose, and is located back of the bridge-wall where it can be repaired, if necessary, without disturbing the masonry. Fig. 3 illustrates a conduit immediately under the boiler-room floor with an opening directly into the ash pit, which is controlled by a damper, the lever of which is near the door. This is a very good arrangement, as it places the conduit where it can be cleaned at any time by lifting a trap door in the boiler-room floor.

These illustrations refer to the management of a single boiler which forms one unit of a battery, as in all such cases

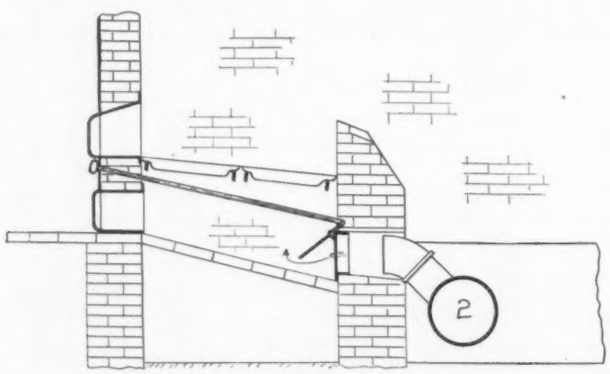


FIG. 2.—DAMPER IN BRIDGE WALL.

the full draft pressure must be maintained in the main pipe, while the delivery to each separate boiler is regulated to suit the needs of the fire in that furnace. A careless fireman will sometimes have all of the feed valves on his boilers closed at once, which causes the relief valve to open and discharge to the sewer. By this means water is wasted and a high pressure put on the pipes, which may not be able to withstand it. If there is no relief valve on the main line, the pressure will soon be high enough to burst a pipe, but in the case of air pressure it does not increase enough to do harm when all outlets are closed, neither does it throw an extra load on the fan engine. In all such cases the admission of air to the ash pit ought to be regulated in connection with the damper in the up-take, because only enough opening should be allowed to the chimney to carry off the hot gases. When this system is properly regulated, cold air does not rush into the furnace when the doors are opened for any purpose, neither are heat and smoke forced out into the boiler room. This is called the balanced system, and is evidently a good feature wherever it can be used.

Such a system is valuable in connection with what is known as a closed ash pit, to which the preceding illustrations refer, but it is still more economical where the closed fire room system is in use. When this is adopted, all possible outlets

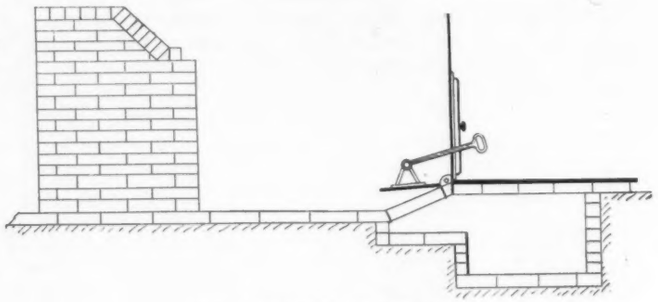
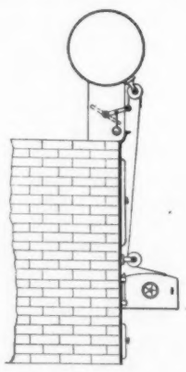


FIG. 3.—DAMPER IN ASH PIT.

for air from the boiler room, except the ash pits, are carefully closed, then whatever air pressure is needed to give the required rate of combustion is maintained in the whole room. The latter plan is used more or less on board steamships and war vessels, but is seldom found in land practice.

The advantages and disadvantages of these two systems may be briefly stated as follows: If air is taken from any point outside of the room and delivered to the ash pits only, the boiler room is not ventilated by the process, hence in marine work especially heat in the room becomes intolerable. However, it can be taken from this room and thus provide good ventilation. In this case warm air must be handled by the fan, which makes it necessary to send a greater volume of it into the ash pits, because a certain weight of air is required per pound of coal burned, and while this weight remains constant, the volume required to give it increases with the temperature



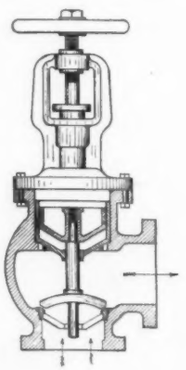


FIG. 4.—AUTOMATIC ARRANGEMENT FOR CONTROLLING DOOR AND DAMPER. FIG. 5.—COMBINATION STOP VALVE.

at the rate of 1 per cent for each 5 deg. Fahr. For illustration, suppose that air is taken from outside the room at 70 deg. Fahr. A certain volume is required per minute; but if the piping is changed to take air from the boiler room at 100 deg. the increase in volume is 6 per cent and if the boiler room is 125 deg. the increase is 11 per cent; therefore, the fan must be run at a high rate in order to secure it. As the power required to operate a fan increases as the cube of the speed,

an increase of 11 per cent in the volume required calls for an increase of 37 per cent in power.

When air is taken from outside and a pressure is maintained in the boiler room, the air is driven in through the ash pit doors very steadily, hence there is no chance for thinking that it is forced through the grates at greater velocity at some points than others, thus burning holes through the fire and wasting heat. The boiler room is thoroughly ventilated by the

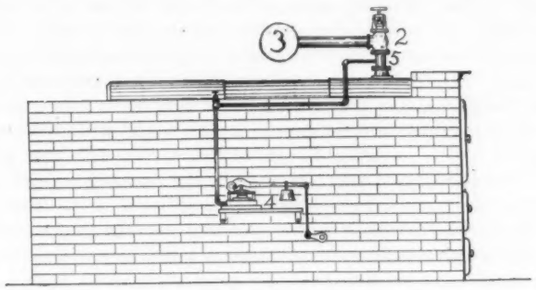


FIG. 6.—BOILER EQUIPPED FOR INDEPENDENT REGULATION OF AIR BLAST.

process, provided air is delivered at proper places and the lowest possible volume is handled by the fan, so that the latter is economical in the use of power. In order to secure this result, however, it becomes necessary to provide a perfectly tight boiler room, as a few small leaks around doors and windows will allow enough loss of air to equal the advantage gained by handling cool air. Two doors a few feet apart are required in the passageway leading to such a room in order that only one may be open at once. When the furnace door of a boiler is opened under such conditions, air rushes in very rapidly and impinges on the crown sheet unless measures are taken to prevent it; therefore, a connection should be made between the door and the damper so that when one is open the other will always be closed. Fig. 4 illustrates the principle involved, but the details of its application will depend on conditions.

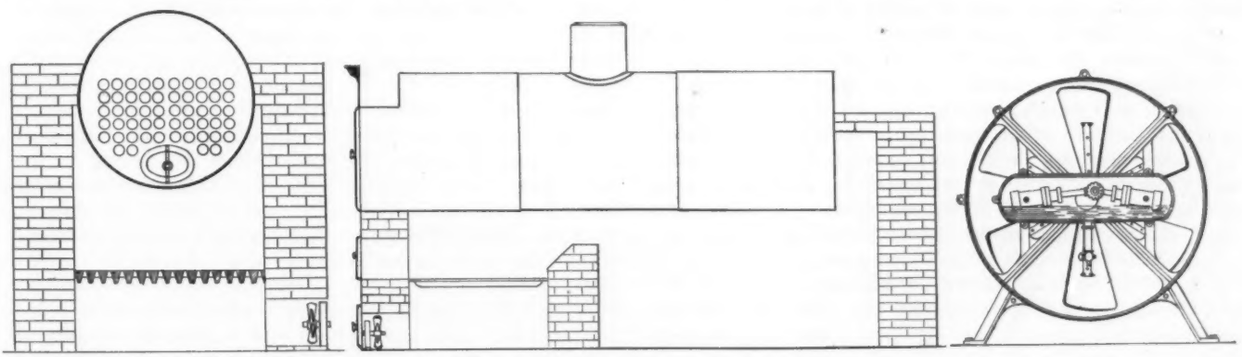
The illustrations show the application of forced draft apparatus to boilers, in which the air is forced into a conduit that is common to all, and the amount delivered to each furnace is regulated by hand. At the present time, when almost everything about a steam plant is regulated automatically, the supply of air ought to be controlled in the same way. The principal difficulty experienced in doing this, where an intelligent preparation has not been made for such service, is owing to the fact that while the fire under a certain boiler may be low, the steam pressure on the main line is still at its maximum, as it is kept up by the other boilers, hence if not prevented by a special appliance, some of it comes back into the boiler that is not generating enough steam to accomplish its share of the necessary work.

This is always liable to happen when it is necessary to clean a fire with a full load on the boilers. There being no fall in pressure on this particular boiler the damper regulator does not change its position, hence no regulation is possible under these conditions, except by hand. There is a practical way to overcome this difficulty, however, if a separate regulator is supplied for each boiler. This is not an extravagant proposition, because first-class regulators are now sold at a very low price, and they save enough to repay their cost in a short time. Fig. 5 illustrates a combination valve to be used as a stop valve on each boiler. When steam enters the lower part of the body of this appliance and sufficient pressure accumulates to raise the disk, steam is discharged at the outlet, as shown by the arrows. If for any reason the current of steam attempts to flow in the opposite direction, the disk promptly falls to its seat, closing the passage and preventing this action.

Fig. 6 illustrates one boiler of a battery that is properly equipped for independent regulation of the air blast for forced draft. The automatic non-return valve is shown in position at 2 through which steam is discharged into the header 3. The damper regulator 4 is connected into the riser 5 just below 2, and, therefore, it is controlled by pressure in that particular boiler and not that in header 3. The operation is as follows: Suppose that the fire in this boiler is to be cleaned, and as a natural consequence no steam will be made in it until the new fire is burning briskly. Pressure falls about 1 lb. and the non-return valve closes promptly. The pressure falls about 1 lb. more and this operates the damper regulator, the effect of which is to open a balanced damper in the air pipe, by means of which the blast is admitted from the main conduit into the ash pit. This soon starts the fire and in a short time the boiler will be discharging steam into header 3.

Another plan for utilizing forced draft is to install a separate fan for each boiler, which is not as complicated as it may at first appear.

In this case the regulator above mentioned would start and stop the fan illustrated in Fig. 7. This fan is driven by direct connection to a small steam turbine which occupies but very little space, hence it can be installed in any place suitable for the fan. The exhaust steam from this engine goes into the ash pit with the air and thus prevents the formation of objectionable clinkers. It also heats this air practically after it has passed the fan, therefore the increased volume due to expansion by heat is not handled by the fan, as it comes to this point at the temperature of the boiler room. If it is not convenient to set the fan in the side wall, it may be located to send air through a passage provided for it in the front wall, near the ash pit door, as illustrated in Fig. 8. This is an ideal arrangement, but where a fan is to be run by a belt from a comparatively low-speed engine a double-cylinder oscillating engine is preferable, since this will start from any point, as it has no dead centers. Fig. 9 illustrates a direct-connected fan and engine which is very useful where it is not convenient to drive by a belt from a pulley on a line shaft. A motor-driven fan might also be employed.



FIGS. 7, 8 AND 9.—APPLICATIONS OF FANS TO BOILER FURNACES FOR DRAFT PURPOSES.

LETTERS ON PRACTICAL SUBJECTS

SMOKELESS COMBUSTION OF SLACK AND NATURAL GAS.

In the natural gas fields of Pennsylvania there is a very cheap grade of bituminous slack coal to be had at little cost. The objection to this fuel, however, is that it is very hard to burn and in addition is very smoky, although the latter property is not always objectionable in the western part of Pennsylvania where smoke ordinances are not known. By a combination of bituminous slack and natural gas as fuel, it is possible, however, to operate boiler furnaces smokelessly. This has actually been done in a Pittsburgh iron works. The bituminous slack delivered at the works costs approximately $1 a ton. By burning it with a small amount of natural gas, the requisite amount of oxygen and heat necessary for the ignition of the volatile gases were obtained and smokeless combustion resulted. Plain, stationary grates are used in the boiler furnaces for the slack and the gas is injected about a foot above the grate level with the result that the flame plays over the entire bed of fuel. Five jets of gas are inserted in 4-in. open thimbles in the side wall of the setting. Both systems had previously been installed to enable either to be used, without, however, becoming wholly dependent on either one. The gas costs 10 cents per 1000 cu. ft., and although it is now used principally to promote the combustion of the cheap fuel and also to prevent smoke, the result is that the monthly cost of fuel for operating the works is much less than when either fuel is used alone. By decreasing the opening between the bridge wall and the shell of the boiler and admitting an excess of air over and under the grates the best results are obtained. In the plant under discussion the bridge opening is reduced to an annular space 5 in. wide conforming to the shape of the boiler shell. Of course, not all cities have natural gas at low rates nor can slack be obtained delivered in the bin at about $1 per ton, but the system of firing described might be tried in places where natural gas is available and where bituminous slack can be obtained at a reasonable rate. As in the case of the iron works in Pittsburgh, it will probably be found that the combination may be burned at less expense and that almost smokeless combustion will result. If either condition obtains, the scheme is worthy of perpetuation.

Allegheny, Pa. W. F. Murphy.

SOME EMERGENCY BOILER REPAIRS.

It is often quite a problem to make emergency repairs; but to do so and keep the engines running all the time is an entirely different matter. Of course, there are some repairs which cannot be made without shutting down the plant and drawing the fires from beneath the boilers, but there are other repairs which can be made if the engineer in charge of the plant exercises sufficient ingenuity. To cite a case: A young engineer found a tube leaking so badly that he was afraid that it would blow out entirely and shut down the plant completely. He immediately went to the stock room and hunted for a ¾-in. rod 12 in. longer than the boiler and cut a thread on each end, running on the thread until the threaded portion was at least 6 in. shorter than the boiler tubes. Two cast washers were procured and some cut washers and asbestos packing, with a pair of nuts, completed the outfit with the addition of a pair of smaller cast washers which would just slide inside of the tubes. The large cast washers were large enough to cover the ends of the leaky tube.

The leak had developed in the back end of the tube, and the rod was put in from the front and pushed through far enough to allow the nut and washers to be put in place on the rod without burning the hands in the escaping steam. The small cast washer was put on the rod first, then some asbestos packing, then the large washer, then a small piece of packing which fitted as closely as possible to the rod, then a cut washer and the nut.

The rod was then pulled back until the packing and washer were almost, but not quite, against the boiler head. The small cast washer was pushed into the boiler tube and served to center the rod in the tube, also to prevent most of the steam from blowing to the front through the tube. The long threads on the rod permitted an adjustment of this kind and still permitted the rod to project beyond the front end of the boiler.

The front end of the rod was then made up in a manner similar to that described for the back end, the small washer being pushed into the tube. The rod was then found to be quite accurately centered and the outside washers hung fairly over the ends of the tube. The rear-end nut was screwed up as far as possible, then the nut at the front end was tightened until all steam escape had stopped, whereupon the engineer went about his business, merely keeping an eye upon the rod and giving the front-end nut an occasional turn with the wrench. This was found necessary for a short time, until the packing had settled into place and stopped changing form under the heat pressure. Then no further attention was needed and the tube thus stopped off did not leak during the two weeks in which it was necessary to run the boiler before permanent repairs could be made.

A case somewhat similar came to the attention of the writer where repairs were made by the use of two rods through tubes, one on either side of the damaged tube. In this case a bit of ½-in. x 2-in. tire iron, bent flatwise into U-shape, served to bridge across the leaky tube which was closed by a piece of asbestos packing at either end, connection between the packing and the iron U-clamp being made by a smooth, round cobblestone, a little larger in diameter than the tube. The cobbles and the packing made a tight joint against each end of the tube, and the two rods and U-clamps held the cobbles firmly in place.

Another, and much more serious, accident was repaired without stopping the plant owing to the ingenuity of the engineer. A boiler carrying 150-lb. pressure was supplying steam to a small lighting plant through a 6-in. main pipe and a 2-in. auxiliary pipe, which was tapped directly into the boiler for supplying the pumps and some other appliances which required steam independent of the engine pipe. For some cause, either structural weakness or undue strain during repairs, a horizontal elbow just above the boiler, to which was attached by a short nipple the stop valve which cut off steam from the 2-in. pipe in question, split from one end to the other, permitting the 2-in. pipe to fall apart and allowing steam under full pressure to escape into the small monitor located on the boiler-house roof just above the boiler.

The cause of the accident was made evident by the falling down into sight of the detached 2-in. pipe with half of the split elbow still attached. Of course, the thing to do was to close, or partially close, the 2-in. pipe, for no 150-hp boiler can very long stand the demands of an open 2-in. pipe. The steam pressure began to drop, and realizing that something must be done at once, the engineer called the fireman to his assistance and they went on the roof of the boiler house, taking with them a sharp-pointed clinker-bar or poker which was among the fire tools of the boiler, and some rope. The clinker-bar was about 10 ft. long, 1¼ in. in diameter at the end, which was tapered down to a point. The 1¼-in.-piece was about 4 ft. long and it had been welded to a 1-in. bar, which in turn had been fitted with a ⅞-in. bent-up handle similar to the rake and slice-bar usually found in boiler rooms. A window chanced to be nearly opposite the broken pipe end, and about 8 ft. from it. A pane of glass in this window was promptly smashed and the clinker-bar pushed through the opening. After considerable feeling around in the steam cloud, the end of the pipe was finally located, and the engineer and fireman forced the bar into the pipe as far as it would go and kept it there by lashing the bar to the building.

As the inside diameter of a 2-in. pipe is about 2.06 in., its internal sectional area will be about 3.3 sq. in. The 1¼-in. bar has an area of about 1.2 in., hence the opening was not much more than one-third closed by putting the clinker-bar into it. This, however, served to hold the steam escape down to a point where the boiler could take care of the drain upon it and by firing hard and cutting off some unimportant load, the pres-

sure was prevented from falling further and soon came up to normal.

A length of 1½-in. pipe was then procured and a thread cut on each end of the piece, which was about 12 ft. long. A stop valve was fitted to one end of this pipe, and a 1½-in. x 2-in. bushing was provided, but was not put onto the pipe. A 2-in. tee, however, was slipped over the 1½-in. pipe and a nipple was made into a stop valve and placed where it could be caught up readily. The 1½-in. pipe was taken to the roof, some packing wound around it to protect the hands from the heat, then the clinker-bar was untied and removed from the pipe and the 1½-in. pipe juggled around and finally pushed into the pipe in place of the bar. The 1½-in. pipe fitted nearly tight inside the 2-in. one so that after it had been lashed in place and the valve on the end closed, very little steam escaped from the broken pipe and it was a very easy matter to slide down and place on the 2-in. tee which had been slipped over the 1½-in. pipe. It is probably unnecessary to state that when this pipe was being inserted into the end of the 2-in. pipe the valve on the outer end of the 1½-in. pipe was wide open and the steam allowed to blow through, so as to reduce the pressure against the end of the pipe sufficiently to allow it to be forced into the larger pipe. Once in place, there was put in the tee-branch opening the 2-in. valve with the nipple, described above. Next, the 2-in. valve was opened, then the 1½-in. valve, then the 1½-in. pipe was unlashed and removed so that the 2-in. pipe was left momentarily open to the atmosphere again. The bushing was then made on the end of the 1½-in. pipe, which was replaced inside the 2-in. pipe—an easy matter with most of the steam escaping through the 2-in. valve. As soon as the 1½-in. pipe had been made in again, both valves were closed and the repair job was done. It only remained to connect the fallen 2-in. pipe with the 2-in. valve which had been nippled into the 2-in. tee. After that, the 1½-in. pipe was removed at the leisure of the engineer, and a plug inserted in the tee in its place. All the operations described above were made within an hour and before the water had become dangerously low in the boiler. This point is not a vital one in these repairs, as the boiler feed was by means of a belted pump driven by the engine, the steam pump and injector being used as auxiliaries.

WILLOUGHBY, OHIO. JAMES F. HOBART.

TRUING AN EMERY WHEEL.

The cost of files used in and around an engine room and power house may be greatly reduced by maintaining an emery grinder in a corner of the boiler room. An emery wheel should not be used in the engine room because the flying particles of emery which are torn off when the wheel is working float in the air and lodge on dynamos, engines, etc., with harmful effect. Therefore, an emery wheel should be placed in the boiler room, or, better yet, in an isolated room.

To be of much use the emery wheel should be kept concentric with the shaft upon which it turns. Some kind of tool for dressing the face of the emery wheel is an absolute necessity. No wheel can be kept in good condition without such a tool, which may be purchased for a few dollars. There are several kinds of wheel-dressing tools in the market and those with black diamonds set in suitable holders are much used and are preferable for very fine work where it is necessary to give the wheel special shapes. For dressing a plain, flat wheel-face, however, that form of tool is sufficient which consists of several corrugated disks arranged side by side on a pin between two supporting yokes.

When a tool, as described above, is held against the face of a wheel and rigidly supported against the anvil or rest which is attached to all wheel-stands, the revolving disks split off the high places in the wheel and do not attack the low spots. Sometimes not even one of these cheap tools is to be had and the engineer with a wobbling wheel and a "must" job to be attended to has no time to hunt a wheel-truing device which may not exist outside of a supply store. In such a case half a dozen washers which will just slide on a ½-in. bolt may be used. They should be slipped down close to the head of the bolt, and the anvil of the grinder adjusted so that by taking a pry over the anvil with the bolt, which should be at least 18 in. long, the washers can be held against the wheel with force enough to make them take hold of the surface. It will not require as much force as one might think who has never tried to true a wheel in this manner. The tool thus improvised must be held so that the washers form a slight angle with the face of the grinding wheel and the angle must be in the direction which will cause the washers to crowd against the head of the bolt. If the angle be in the opposite direction, the washers will all run up the bolt and away from the wheel to be dressed. If one of the handles used for holding the corrugated disks is at hand, it may be used instead of the bolt, and when the supply of disks becomes exhausted, washers may be substituted for the disks with good results. The tool, however, will not cut quite as fast with washers as with the corrugated disks.

PITTSBURGH, PA. B. J. HORNE.

CALKING AND PATCHING BOILERS.

If a boiler is always repaired just before repairs are needed, it is safe to say that the boiler will never be in need of repairs and that it will never leak or blow a tube. There are many small repairs which can be made by the engineer, which, if made in time, may prevent larger repairs necessitating the shutting down of the plant. The simplest of all repairs is the calking of a leaky rivet. Next comes the calking of a leaky seam. These two repairs should always be made as soon as the leak is discovered. Leakage of this kind, if allowed to continue, will eventually cause the corrosion or wasting of the sheet or plate down or across which the leakage has found its way. When water or steam at the temperature due to high-pressure steam comes in contact with equally hot steel, the conditions are just about right for the speedy union of the oxygen contained in the water and the steel. The result is a body of oxide which is constantly growing deeper and is replacing the solid steel with the worthless and brittle layer of rust. If leakage of this character is permitted to continue indefinitely there can be but one result: the sheet or plate will be corroded completely through, leaving a hole in the boiler. Of course, the leakage must be long-continued in order to perforate a boiler shell in this way.

Every engineer should have two or three calking tools in his kit. To make a calking tool in a hurry, select a very heavy cold chisel (one made from ⅞-in. or 1-in. octagon steel is the best), and forge or grind the end off until it is about ¼ in. thick. Then round the end of the tool until it is a perfect half-circle ¼ in. in diameter and at least 1 in. wide. Place this tool against the slope of a rivet about 1/16 in. from the shell plate and strike the tool with a hammer, keeping the tool inclined more or less parallel with the shell of the boiler.

The result of hammering the tool in this manner is to sink a groove in the edge of the rivet, and to drive the metal of the rivet down upon the shell so tightly that nothing can pass out between them. This is all there is to the calking of the longest seam or joint in a boiler. If the tool is moved along as the hammering proceeds there will be a shallow, rounded channel formed entirely around the rivet or across the sheet, effectually closing the opening between the sheets against leakage.

When a leaky rivet or seam is found, instead of letting it go until a boilermaker can be brought to the scene, the engineer should take a hammer and calking tool and stop the leak, which can be done in a few minutes. Caution should be used in calking a leak if the boiler is under steam. It may be considered safe to calk a boiler under steam, but the writer does not consider it at all advisable and never does it in his own practice. Calking a seam against 150-lb. boiler pressure would never be done by the writer unless it were absolutely necessary, and that is seldom the case if leaks be taken in hand when they first develop. If leaks must be calked when the boiler is under steam, then the steam pressure should be lowered at least one-third before attempting to calk anything more important than a single rivet, which, were it to lose its head during the calking operation, when under pressure, could not result in serious accident. Calking under cold-water pressure, in new boilers, is sometimes

practised, but even that, when at or above working pressure, does not seem desirable to the writer.

Repairs which necessitate the putting on of a soft patch can sometimes be handled by the engineer with good results. A soft patch is of no use when it must be located where the fire will reach it or intense heat will play against it and where there is no opportunity for water to get at the other side of the patch. When it is required to close a hole or a crack located where the fire cannot burn the metal, then good results will be obtained from the use of a patch bolted on. To put on a patch of this character in such a manner that no calking will be necessary it should be fitted as closely as possible by heating and forging. The holes may then be drilled and those in the shell beneath the patch tapped, or drilled large, and through-bolts used. Tap-bolts are preferable, for jamb-nuts may be put on the bolts inside the shell and leakage through bolt-holes prevented.

After the patch has been bedded and fitted, coat the inside of the patch and the outside of shell, where the patch is to come, with Portland cement, mixed with sufficient water to make it into a paste which will spread, but which will not run when the sheet is turned upside down. Wet the metal before applying the cement paste and make sure that the surfaces are clean and free from grease, especially. When the patch is in place and the cement is between the surfaces the bolts may be inserted and screwed down to within ⅛ in. or so of where they will be when fully screwed home. Then let the joint stand about one hour, depending on the cement used. It should stand until the cement just begins to set and not after. This may be determined by testing the protruding fringe of cement around the patch. Just as the cement begins to refuse to flow readily, screw the bolts tight, putting an even strain on each, and let the job stand 10 hours—24 hours if possible, but 10 hours will do. The boiler may then be fired without any sign of leakage. The cement hardens as much in a few hours under steam heat and pressure as in 28 days in the open air.

Detroit, Mich. James Francis.

MOTOR-CONTROL OF FLYWHEEL GOVERNOR.

In alternating-current generating stations some means of controlling the speed of the engines from the switchboard is always desirable, since by this method the alternators can be synchronized and thrown in parallel more easily than where the alternators and engines are not under the direct control of the switchboard operator. The writer has seen a very neat arrangement for controlling governors of the flywheel type, which is so simple that others can easily apply it. Strapped to the hub of the flywheel is a small direct-current fan motor. By means of a spur and worm gear this motor drives a screw which tightens or loosens the spring which counteracts the centrifugal force of the shaft governor weights. In order to prevent the motor from causing damage by continuing motion after the screw has reached the limit of its travel, a friction clutch is provided in the gear train. Four collector rings are mounted on the shaft adjacent to the collector rings of the revolving field, so as to make the motor easily reversible. A small triple-pole double-throw switch on the generator panel of the main switchboard controls the motor circuit. By throwing the switch up, the motor revolves in a certain direction, stiffening the governor spring and thereby increasing the speed of the unit. By throwing the switch down the reverse action obtains. With the switch open, the motor, of course, remains stationary. By such means the alternators may be synchronized with the governor, which is preferable to synchronizing with the throttle, and the engine speed is under the control of the switchboard operator. When starting up a machine and synchronizing it with one or more already running under load, the governor of the machine will, of course, tend to adjust its engine to normal speed. The machines already running, however, owing to regulation drop will have a speed slightly below normal, say about 2 r.p.m., so that the synchronizing lamps will have a perceptible beat. In order to decrease the speed of the engine to that of the machines on the busbars, the governor spring is slacked by means of the motor described. If the engine is reduced in speed so that the r.p.m. are the same as those of the machines on the busbars, the machine being started will take none of the load when thrown in until its governor spring is again tightened up, tending to pull in the governor weights and admit more steam at the speed at which all the machines are running in synchronism with one another. The scheme described also gives a ready means of shifting the whole or any part of the load from one machine to another at any time, and of gradually throwing the load entirely off of any machine before opening its switch to shut it down. In this way a generator can be cut out without affecting the load on the others in parallel with it at the instant when the switch is opened, and thereby without disturbing the voltage.

Boston, Mass. Ludwig Bergman.

CONDENSER EFFECT IN TUNGSTEN LAMP.

I have had a peculiar experience recently in connection with tungsten series lamps. I went up a pole to examine a lamp which was not burning because there was no mica fuse in the clips, and while hanging onto the pole with one hand, I took hold of the lamp bulb with the other to withdraw it from its receptacle. I was surprised to see the lamp immediately give off a white light somewhat similar in its nature to the light from a mercury-vapor lamp. Not only was the entire bulb filled with this light, but the tungsten filament glowed with a distinct white color. I tried placing my hand on the lamp several times and each time observed the same effect. I have often replaced Gem lamps on this circuit, but never noticed the phenomenon in connection with them. The circuit carries a tension slightly above 5000 volts and the current strength is 3.5 amp. Has anyone else noticed this phenomenon?

Brattleboro, Vt. Leon C. White.

PROTECTING ALTERNATING-CURRENT CABLES.

In switching in and out parts of the network of leads formed of concentric cables on alternating-current lines, there is danger of a discharge taking place between the outer conductor and the lead armor. These discharges can be prevented when the current is first switched on to the network by connecting the outer circuit before the inner; and when disconnecting by breaking the inner circuit first and then the outer. By connecting the outer circuit to earth at only one point and in series with an inductionless resistance when the inner conductor becomes grounded, the current will not be greater than that necessary to blow the fuse of the inner conductor. With twisted cables this method is not applicable. In such cases fuses should be installed at both ends, the fuses at the remote end being smaller than those at the station end. No fuse should be used with the outer conductor when concentric cables are used; but in complex networks, the outer conductor should be grounded as suggested above.

Baltimore, Md. George Ladour.

INSULATING PROPERTIES OF VARNISHES.

Troubles are often charged to insulating varnishes that would be absurd, were it not for the real seriousness of the cases involved. For example, one winder of a certain armature failed to place a block at the pinion end to make the coils at that location of the proper height. As a result they sagged, so much so that it was impossible to retain the band wires in place. This armature happened to be the first one to be coated with a new make of finishing varnish. Before one trip had been completed the armature was ruined. The bands were off, the coils were thrown out and totally destroyed. Soon it was reported that a certain make of varnish was poor, for a certain road had had serious trouble with it and had decided not to use it. When the winder was approached in regard to his statement against the varnish, he replied: "The company requires a reason for every burnout and trouble of all sorts; and I had to protect myself." No amount of work could undo the injury started by this story, which was widely quoted.

There is so little known concerning insulating varnishes that

some ridiculous ideas are advanced. One man said he could not use a certain insulating varnish; on further questioning, he said he could not swear that the varnish was at fault, but the armature gave trouble, and he, too, must protect himself.

There is sometimes a hidden reason for condemning a varnish; the man who cannot resist temptation is pointed out, and the stigma follows him. Sooner or later his employers learn the true conditions, and then it is hard for him to be again re-established. A certain salesman once said: "If your man says that our varnish is not the best he ever used, it would be best for you to change the man in that department!"

In a certain case a short circuit developed in a commutator, due, it was said, to the use of a certain insulating varnish. The trouble was probably caused by solder falling back of the commutator, as often occurs; unless tested before starting, the solder will not ordinarily be discovered. This trouble is common, especially where muriatic acid is used as a flux. Many very large and valuable armatures have been ruined from this cause alone. One would be surprised, on visiting the shops throughout the country, to learn what strong acid is used in this way. Soldering pastes or rosin, or the solution recommended by the underwriters, or alcohol and rosin, are positively safe. If any trouble occurs to a commutator after repairs, when insulating varnish was used as a finishing coat, there surely must have been other troubles not located. In all cases cited here, the brush e.m.f. was not above 550 volts. The e.m.f. between segments is very low, so there could certainly be no short-circuit produced in that case. If a "ground" developed at the end of the commutator, the mica insulation was rotted out from oil and dirt, or had worn too thin. Perhaps the commutator had worn too thin to carry the regular current without overheating. Sometimes insulating rings are not put back properly after having been repaired; there may have been too much moisture in the mica rings when replaced. Particles of copper may have been left in the inside shell and lodged long enough to cause the trouble. In any case, there are many more chances in favor of the varnish, than against it.

Too strenuous a use of a machinist's hammer, with a flat file placed over the coils when hammering them into the slots is objectionable. If the coil is difficult to move, the workman continues to hammer at it, and even though the wires may be crossed, they are hammered until they fall in place. It is certain that vastly more burnouts are caused by poor workmanship and an "I-don't-care" spirit than can be charged to defective insulating varnish. The writer has never known an insulating varnish made by a reliable company to cause any troubles such as these cited.

There is such a thing, however, as abusing a good varnish. Too much thinning, for one thing, is bad. With such thin material, if a 500-volt armature is used when the material is wet, a short-circuit may be caused. This result should be charged to the gasoline used in thinning, not to the varnish. Varnish is sometimes condemned because of the ignorance of the buyer. For instance, a man who does not possess a baking oven buys a baking varnish instead of an air drying varnish. The material will not "air-dry" in 24 hours, and he believes that something is wrong with the varnish.

There are not many classes of insulating varnishes; four will cover them all, as follows: Clear insulating, black baking, black air drying, and black shellac. The clear insulating varnish can in some cases be used as air drying, but it is really a baking varnish. The second can be used similarly, but it should ordinarily be baked. The third can be baked if so desired, but is used mostly as air drying only. The fourth, black alcohol shellac, is used only as air drying. Some repair men use this last for all kinds of work in quick repair shops, as no baking is required. They prefer a different material, especially as the price is so high, but the class of work that comes to them demands the use of this kind of varnish. The work about street railway shops where no coils are made requires only a black air drying varnish. If coils are made and an oven is at hand, by all means use should be made of a black baking varnish. There is still some difference of opinion as to the clear varnish, but the great majority of buyers have abandoned it as far as coil work is concerned. Likewise shellac is almost a thing of the past in repair shops.

Transformers treated with insulating varnish usually employ the clear insulating variety; many concerns do not use the varnish on the wire, but instead use linseed-oil-treated cloth. It is a fact that a cotton-covered wire if untreated and wound with insulating cloth or linen tape treated with clear varnish —which is largely linseed oil—will show the same result as is caused by acid; the verdigris cannot be eliminated.

It is instructive to note the result when a large coil is treated with an insulating varnish and the baking is insufficient to render the interior of the material dry. When use is made of a yellow varnish, linseed oil product, or any of the clear varnishes with oil or turpentine, even though the outside is baked hard, if the interior is moist there will be a chemical action which will eventually ruin the coil. If electric current is applied for some time to this coil it will dry out the inside thoroughly. If the motor or generator so treated were put on a light road, the same thing would occur. However, this precaution cannot be done in regular manufacture, because the process is too costly. On the other hand, if a good black baking varnish is used, the coil is not liable to the same degree of injury. Indeed, the writer knows of varnish that is neutral, at least to such an extent that no burnouts are ever caused by it. It is noteworthy, however, that certain insulating varnishes will rot the fabric. Not long ago the writer observed some linen tape which was being taken from a field coil of a well-known make. The tape that was free from black insulating varnish was perfectly good, but the tape on which black varnish had been used was very rotten. Undoubtedly there had been a deleterious chemical action in the varnish.

For treating coils, air-drying varnishes were not mentioned above; there are several good ones on the market, but the writer seldom recommends them for coil work. One point against them is that they do not possess the high degree of penetration obtained by the purely baking varnishes. As to solid insulating compounds, there is still much to be desired from these materials. In impregnating tanks, if new compound cannot be frequently added, trouble and dissatisfaction follow. If the solid material can be forced into the coil without leaving bare places on the cotton insulation, the result will be satisfactory. However, the strength of a coil is that of its weakest spot; and it is not fair to assume that if there are untreated spots, the coil is just as good as if the varnish had perfect penetration. With large coils there exists the possibility of bare places. All coils should be hot before dipping in order to get the best results. There will not be the same amount of solid material carried to the coil in liquid form, but there is adequate penetration and a reasonable amount of varnish in coils used for street railway service, for example. With lifting magnets, the case is different, vacuum systems being then necessary. There may be trouble with gases from gasoline-thinned varnish in treating lifting magnets if they are sealed; the solid compound is free from the latter fault.

The whole subject of insulating varnish has been treated for years as a great mystery. Wonderful tests have been made with startling results. Each manufacturer used an argument to make it appear that his varnish met all conditions and was the best made; the other manufacturer employed the same argument, although his varnish was diametrically opposite in nature to the other. After reading the leading arguments of each, a novice is at a loss to know the facts, unless he has personal knowledge of the materials; there are contradictions, many being absurd. One thing at present needed is literature for the shopmen which will make a few things plain as to what is expected of insulating varnishes, so that the right one may be recommended for the work in hand. As all varnishes are practically sold on approval there is little chance of misrepresentation. Each varnish offered possesses some good points for certain duties.

CHICAGO, ILL. A. B. WEEKS.

QUESTIONS AND ANSWERS

Can you tell me what distinction is made between the expressions "foot-pound" and "pound-foot"? D. E. C.

The unit of work is the foot-pound, or the amount of work done in lifting 1 lb. through 1 ft. of space. It is customary to reverse this unit where torque is meant, torque being usually expressed in pounds at 1 ft. radius.

Can arc lamps be operated on 25-cycle circuits with any degree of satisfaction? C. C. U.

Arc lamps are operated on 25-cycle circuits, we believe, on the outskirts of Niagara Falls, N. Y., where any flickering would not be objectionable. It has been suggested that where large areas are to be lighted by a number of arc lamps on a low-frequency polyphase system, the arcs be divided between the phases, the flicker of those on one phase eliminating that of the others.

Is it possible to counteract sparking at the contacts of bells, etc., containing electromagnets? R. W. D.

The sparking at the contacts of local telegraph circuits is said to be considerably reduced by winding the magnet with two wires on the duplex principle, that is, the two wires lying side by side throughout their length and connected in series. In fact, it is claimed by this means that sparking can be almost eliminated. The effect is probably due to a condenser action between adjacent turns having considerable difference of potential, the electrostatic charges from which balance to a certain extent the self-induction. A resistance shunted across the circuit may also serve, but best of all is a condenser.

How can I arrange a bi-polar generator so as to be able to obtain direct current as before, and, in addition, alternating current? A. Z. G.

On the end opposite the commutator mount collector rings for the alternating-current circuit. If single-phase alternating currents are wanted, use two collector rings; tap one into any coil and note to which commutator segments that coil is connected. Tap the other collector ring into the coil connected to the commutator segment diametrically opposite that connected to the first ring. If two-phase currents are required, add two more collector rings and connect them with coils connected to segments at right angles to those already used. If three-phase currents are wanted, use three collector rings and connect them respectively to coils connected to commutator segments 120 deg. apart upon the machine.

Can the damaged armature of an exciter be tested with energy from the alternating-current mains? If so, how may a burn-out or short circuit be found by this means? R. B. P.

In testing for a burn-out, run two leads from the alternating-current mains and place an incandescent lamp in series with one of them. When the leads are applied to opposite points of the commutator, the lamp will usually give a diminished candle-power owing to the choking effect of the armature winding. If on touching the wires to the commutator at points 90 deg. apart the light becomes dimmer, it would indicate that the burn-out is within the 90-deg. section between the wires. When the wires are on the adjacent bars of the open coil there will be only one path for the circuit and that is through the rest of the armature, the choking effect of which will be sufficient to cause the lamp to burn with only a very dull red color. When testing for a short circuit between adjacent bars, a bank of lamps should be employed so that when the test wires are applied to two adjacent bars between which no fault exists, the lamps will give about one-half normal candle-power. On touching the pair which is short-circuited, the lamps will burn with full brilliancy.

What is the osram incandescent lamp and wherein does it differ from the osmium incandescent lamp? M. F.

"Osram" is the name under which the first commercial tungsten metal-filament lamps were introduced by the manufacturers, a German concern. The osmium lamp has a filament of metal of that name made by sintering finely divided metal at such a temperature that platinum evaporates, which temperature is sufficient to destroy the binding material used in the manufacture of the threads. The filament thus obtained withstands a very high temperature; but is still of a more or less spongy or porous nature, very metallic and nearly solid. The difference of the filament of the osram lamp, which is pure tungsten metal, from the filament of the osmium lamp is that the former will stand a temperature at least 100 deg. C. higher than the osmium filament. The specific resistance of each differs, and the color of the osram filament is a steel to a silver gray, while the color of the osmium filament has a bluish-gray appearance. The osmium lamp is very expensive and is only applicable to low-voltage circuits. It is not used to any extent in this country and only to a very limited extent abroad. Both the osmium and osram lamps are the invention of Auer von Welsbach, and his inventions in this field came as a sequel to his classic work on rare elements for the incandescent gas mantle known by his name. The osmium lamp is interesting historically, although not many years old, as marking the advent of metallic-filament lamps.

In wiring a large factory for telephone service are the ordinary weatherproof and annunciator wires available for such work? If not, what class of wire is best for this purpose? P. B. C.

Experience has shown that only rubber-covered wire will give satisfaction when used in buildings for telephone purposes. The wires should be of well-tinned, soft copper, No. 19 gage. Each conductor should be evenly and smoothly covered with an approved rubber insulating compound of an outside diameter of not less than 3/32 in. The insulating covering should be flexible and not liable to deteriorate under ordinary conditions, nor to act injuriously on the conductor. Each insulated conductor should be covered with a close braid of cotton or other approved material. This should either be of polished cotton or treated with a compound insoluble in water. The braid of one wire should have a raised thread or some such marker so that the wires in the twisted pair may be easily distinguishable. The two wires of the pair should be twisted together, the length of the twists varying from 1¾ in. to 2½ in. The completed wire should be capable of withstanding a pressure of 1000 volts, alternating current, and should have an insulation resistance of at least 200 megohms per mile at a temperature of 65 deg. Fahr. Wire fulfilling the above specification is on the market.

We have a 90-kw, single-phase alternator of the revolving-armature type, equipped with a commutator and auxiliary field winding. This compensating winding is supplied with current from a series transformer built on what may be called the spokes of the armature. We were told that when the machine was well loaded, this commutator or rectifier might give considerable trouble from sparking, etc., and that we could run without it by taking off the end piece from the commutator and short-circuiting the two wires which would be the secondaries of the series transformer and connecting the compensated field winding in series with the main field. Would such an arrangement be satisfactory? W. M. D.

A self-compounding single-phase alternator may be operated as a plain self-exciting machine without any difficulty whatsoever. It is necessary merely to short-circuit the commutator, which can be conveniently done by wrapping copper wire tightly over the segments and by removing the brushes from the commutator. In this way the machine will be converted into a separately excited generator, the voltage of which will decrease with increasing load and can be maintained only by regulating the field-circuit rheostat. It is not necessary to remove the commutator in order to short-circuit the wires, the plan mentioned above being far preferable. Moreover, it is unnecessary to make any use whatsoever of the few turns on the series field winding; it is far better to omit this winding entirely from the shunt field circuit. The above-mentioned changes can readily be made and the effect upon the operation can be observed. The regulation will be satisfactory only when the attendant watches the voltmeter continuously while the load fluctuates. We suggest that you make the above changes and ascertain if the results are satisfactory under the conditions which exist at your plant.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Analysis of Central-Station Costs.

In a paper presented at the recent convention of the Illinois Electrical Association, entitled "Elements of Cost of Service to the Consumer," Mr. E. L. Smith, of Kewanee, Ill., gave an analysis of central-station costs. Too often, he said, we hear of lighting companies, especially in the smaller towns and cities, producing current at a remarkably low cost per kw-hour, sometimes as low as 1¼ cents. Central-station men, in giving cost of current, are too apt to give coal cost alone, which is only one of the many items that go to make up the cost at the consumer's meter. Every plant, no difference what its capacity, should be equipped with an integrating wattmeter. It is just as essential to have a station meter in an electric-light plant as in a gas works, from which it is never absent.

The analysis below applies in general to stations ranging in capacity from 200 kw to 500 kw. The items that go to make up the cost of current at the consumer's meter are classified under three general accounts: Manufacturing, Distribution and General Expense.

The following items are chargeable to manufacturing expense, which account should show full amount chargeable, and the cost per kw-hour:

Manufacturing—Labor.

Coal, water, oil and waste, miscellaneous supplies and expense, station light.

Station Maintenance.

The above gives the kw-hour cost at the switchboard.

Under Distribution are chargeable the following items:

Public Arc Lamps.

Labor, carbons, globes, miscellaneous, stable expense, store room, etc.

Public Incandescent Lamps.

Labor, lamp renewals, miscellaneous.

Commercial Arc Lamps.

Labor, carbons, globes, miscellaneous.

Setting and Removing Meters.

Complaint Expense.

Commercial Incandescent Lamps.

Renewals.

Gratuitous Work.

The total of these accounts gives the manufacturing cost of current distributed.

Distribution maintenance items are also chargeable to this account, and include the following:

Lines and services, public arc lamps, commercial arcs, public incandescents, transformers, meters.

General expense is the last division of cost items, to which are chargeable the following:

Manager's salary and light, officers' salaries, meter readers, rent, light, miscellaneous expense, accident insurance, fire insurance, legal expense, taxes, accidents and damages, interest on bonds, interest on advances, depreciation, soliciting, advertising, demonstrating, etc.

The total of these items go to make up the kw-hour cost of supply.

Large economies are derived by submitting to the chief engineer and superintendents of departments a little monthly report showing the cost per kw-hour of the principal items in their department.

DISCUSSION.

Mr. A. L. Pond commended the writer of the paper as having given the first definite system to follow to get at the subject of costs that he had seen presented at a convention of this kind. If every central-station represented would take a copy of this paper home and come back to the next convention with the figures filled in opposite the items, there would be surprise among many at what it actually costs.

Mr. William L. Clarke said it was surprising to observe the general lack of information on the part of the average small company as to its own affairs. While it might be the case in the larger companies that the bookkeeper wanted to dominate the business, thinking his own department the most important, it seemed to him the contrary was the case in the smaller companies. The bookkeeping end is submerged to the point where there is practically no bookkeeping worthy of the name.

The Treatment of Complaints.

BY FRED. M. REAST.

Every central-station manager realizes that the good-will and respect of its patrons and the general public is a valuable asset to a public service corporation. At least once a year he determines to put an end forever to customers' complaints, but the magnitude of the task overpowers him and at last he gives up in disgust.

The attitude of the average citizen toward any public service corporation is one of distrust. This prejudice is, in a great many cases, intensified by some misunderstanding which has arisen between the consumer and the electric-light company, for example. To discuss the best methods of remedying such misunderstandings is the object of this article.

It must be remembered that it is a customer's inalienable privilege to complain, and to complain often, and that it is a part of the lighting company's business to receive each complaint and give it prompt attention. A customer's complaint, no matter how trivial, is of vast importance in his eyes and to satisfy him should be the motto of every central-station manager.

The care of this important matter should be the sole duty of a competent complaint clerk. This person should be a man who thoroughly understands his business and is acquainted with every phase of his company's policy toward the public; one who has had practical experience with that bone of contention, the watt-hour meter, and can clearly and forcibly explain the mystery of kw-hours, volts and amperes; one who has an eye open for wasteful or unsatisfactory illumination, and above all who possesses an inexhaustible supply of patience. Such a man is almost as necessary to the proper conduct of a lighting company's business as the general manager himself and should be chosen with care.

To this official should be referred all communications partaking of the nature of a complaint. He should keep a careful record of these and attach to the original complaint a memorandum outlining the date of its receipt, to whom referred for investigation, the result of such investigation and the final disposition of the case.

As the largest percentage of complaints are of high bills, that phase of the subject will be discussed first. It is the usual custom in most companies when a high-bill complaint is made simply to test the meter and if it is found correct, in the great majority of cases, the matter is summarily dropped, or at best the customer is notified that his meter has been tested and found to be correct, etc. Now, this method is radically wrong; first, because the customer is dissatisfied, usually regarding the test as a farce, particularly when the tester is forbidden to divulge the state of the meter; secondly, because the method is expensive, and, finally, because the real cause of complaint, if there be any, is rarely found out, for the average customer only complains because his bill is high and without a moment's consideration blames it on the meter. It is the function of a properly conducted complaint bureau to remedy these difficulties so that the expense of unnecessary meter testing will be done away with, the real cause of complaint discovered and

remedied, and the customer satisfied that he has had a square deal.

When a complaint is received the clerk should make a memorandum of former bills including those of the same period the previous year, if possible, and of such reports as the meter department may furnish regarding the meter or installation in question. This data, together with a knowledge of the installation and the exercise of a little wit will usually convince him whether the cause for complaint is imaginary or not. In every instance, however, he should visit the customer, unless the complaint be simply a comment on an increased bill, and listen patiently to his statement of the case. After a little tactful questioning and an inspection of the installation with regard to lamp distribution and efficiency, voltage, maintenance and the possible existence of grounds, the inspector can usually determine whether or not a test of the meter is advisable. This method of investigation before testing is certainly more logical and economical that that of going blindly ahead and testing every meter complained of. The writer has known of scores of cases where, after the expense of needlessly testing a meter had been incurred, the tester accidentally found the cause of complaint to be a forgotten lamp, such as in a flashing sign, or careless use of light by servants, or in many cases a ground recording on the meter, all of which would have been discovered at far less expense by an intelligent complaint investigator.

When meters are to be tested on complaint, the work should be assigned to an experienced and tactful man. One tester should preferably have entire charge of such work, who should be instructed to give any explanation or information regarding the meter that the customer may desire and do all in his power to explain the method of testing and to convince the customer that he is being fairly treated. If a meter is found fast, the amount of the last bill in excess because of this should be cheerfully returned or credited to the customer's account.

In brief, the function of the complaint clerk is to give unprejudiced and, as far as possible, personal attention to complaints. He should do everything reasonable to adjust every bona fide complaint; be patient but firm with chronic kickers, and thus win for his company the respect, good-will and support of its customers.

Establishing Day Service in a Small Town.

Mr. A. R. Manley, of Mount Carmel, Ill., in a paper presented at the convention of the Illinois State Electric Association, took up the advisability of establishing a day circuit in a small town and gave some experiences. He said that most electric light plants in towns having a population of 5000 or under operate either from dark to midnight or from dark to daylight. If a property remaining idle from 12 to 18 hours of the day can be made to pay dividends, it would appear reasonable that if an income could be obtained from the property during the full 24 hours the profits would be much greater. The fixed charges against the property and the depreciation are practically the same, whether or not a day circuit is operated. Taxes, insurance and office expenses do not stop when the engines are shut down. The additional expenses of operating a day circuit are confined to fuel and labor.

Briefly stated, all the income from current sold in the daytime over and above the cost of the extra fuel and supplies and the salary of an extra man or men, is profit. The question resolves itself into simply one of selling a sufficient amount of current. Every service must be metered before it is advisable to give every patron the advantage of the day circuit, as no flat rate contract could be made that would be equitable to both consumer and central station or that would not be abused. A progressive merchant establishing a store first looks about him for a location and rents the very best building possible, on the busiest street, in the best block. He sees to it that the room is properly fitted up for his business, and he has plenty of show window and display space. This identical procedure will sell day current and will make the operation of a day circuit a success. It has not occurred to possible customers that day service means that they can use it to advantage for operating mills or factories or for household purposes.

Mr. Manley tells of the establishment of a circuit in a plant with which he is familiar which has been giving day service for five years. The conditions at the outset were much the same as in most towns of from 3000 to 5000 inhabitants. The plant operated on a dark-to-midnight schedule, with customers using electricity only for lighting. A day circuit was started, following the methods outlined, and has been a success in every particular.

In the discussion of this paper Mr. Sinsabaugh, of Carrollton, said that he was operating a plant in a town of 2500 inhabitants, and had given day service for about seven years. While he did not consider that it had been a huge success, still he would advise anyone to start day service under certain conditions. If one wishes to give consumers fairly decent service during a dark, rainy day the plant would have to be run until 8 or 9 o'clock in the morning and started at 3 or 4 in the afternoon. It would require just as many men to run during those hours as it would to run the additional hours for a regular day service. If the small plant would start day service, it could no doubt put in a small unit to take care of day load. Consumers appreciate day service, and there are many places like dark corners, closets, pantries and basements where light would be used in the daytime if available. In his own case, he was receiving about $400 a year for lighting in a courthouse which closes at 6 p. m. He found by test that if he had been giving this courthouse night service only he would not get $50 a year from it.

Mr. J. E. Gorham, of Geneseo, speaking of the possibility of getting grain elevators for day load, said that he had run against the difficulty that the elevators burned corncobs, for which there was no other market.

Mr. Frey, of Hillsboro, reported operating an elevator at a rate of five cents per kw-hour, the owner of which claims it cost him formerly about $75 a month for the operation of his steam plant. The electric bill averages about $35. Besides this he has the corncobs to sell.

Mr. A. L. Pond cited another case where it was proposed to put in a motor to drive a feed mill. A little figuring showed that they could grind the corncobs and sell them for almost enough to pay for the whole thing.

Mr. D. Davis reported that the first attempt to give day service in Litchfield during the fan season only was not successful, because there was no other motor load. Two years later the company announced that it would run a day circuit whether it had any load on it or not. After that the load began to come.

Mr. J. W. M. Burton, from Paxton, a town of 4000 to 5000 inhabitants, reported that in a year's time, in spite of the fact that he was told a day service would not pay, his company had 38 motors in operation, ranging from 0.5 hp to 35 hp. The power rates ranged from 8 to 3.5 cents, according to the size of the motor. No flatirons had been sold a year ago when day service was begun. Over 100 have been put out. Thirty-eight fans have been sold for residences. During the season 23 fans have been rented at $1 a month. The day load on direct-current has gone up from 50 kw to 150 kw. Alternating-current power has gone up from 35 kw to 73 kw. He found that the whole secret of success with a day circuit is in letting customers know that service is continually there at the right price.

Mr. Chapman, in a town of 10,000, said he started to push day business about two years ago. He put out flatirons on 30 days' trial at $2 per iron and sold them outright to the consumer at that price. He has almost 400 flatirons installed, 150 having been put in this year. He has three stone-cutters as motor customers. One uses $30 worth per month, with a 15-hp motor. He is supplying three elevators. They have a minimum price of $10, up to which the rate is five cents and above which the rate is three cents. He took one factory, figuring against the previous steam plant, where there was a 100-hp engine. The factory put in 78 hp in small motors. He took this business

at a 2.5-cent rate. Power load which was formerly bringing from $135 to $140 per month is now bringing between $400 and $500 per month.

Mr. Foster, of Fairbury, a town of 3000 people, reported operating a day circuit for six years. He has connected over 150 hp in motors in various sizes, which comprises all the power of every kind used in the town. Five years ago he secured a mill and elevator that had been using corncobs for fuel, and its owners could not be induced to go back to steam. He did not know what the cost of operation had been formerly, but they now pay $50 a month for electric power. He has over 200 flatirons in use and some other heating appliances. He believed it possible for any concern in a town of 2000 or over to make a day load pay.

Mr. E. MacDonald, of Lincoln, speaking of boiler economy in connection with day load, said that the cost of banking fires and starting up again in the evening where night service only was given would help toward operating the plant during the daytime. He personally had been connected with three plants at the time they changed and adopted a day circuit. In all three of those plants he found that when adopting day service it was necessary to put in an extra boiler in order to give a chance to clean the boilers. When that was done, instead of cleaning the boiler hurriedly between morning and evening, the boiler was allowed to cool off slowly, plenty of time was taken to clean it, and it was warmed up slowly. In all three cases he found that the operating of the day circuit actually took less fuel than the night service only, simply because the boilers were kept in better shape.

Mr. J. M. Strasser, of Oak Park, said that he made up his mind to start the flatiron proposition in the month of August, rather late in the season. He arranged for three personal solicitors to do nothing else but solicit for flatirons. These were put out at 15 days' trial at $4 each. By Aug. 28 he had 625 irons out. Next year he said he would put out at least 1000 irons in the same territory, beginning the first day of May. Over 70 per cent of the irons placed have remained in service.

Mr. Hyatt, in reference to the disposal of by-products used for fuel in steam plants, told of a planing mill recently connected-up for 55 hp, upon which he had worked for nearly two years. One of the points brought up in their argument was that their fuel cost them practically nothing, but a new management of the mill saw there was a market for the fuel and made the change.

Mr. J. G. Learned, supplementing Mr. Strasser's remarks about the campaign at Oak Park, stated that his company, the North Shore Electric Company, had carried out a campaign for three years. Last year they put out irons at $4. They were put out on seven days' trial. If they did not hear from the irons the company would bill them. In his territory they had about 1500 irons, and wanted about 1000 more. His idea was to continue campaigning for flatirons at all times with a view to putting an iron in every house. His company is considering putting irons out on trial and letting them remain for a year. At the end of the year they either take the irons back as second-hand, or give the customer the opportunity to buy at half price. This would not cut into the price on new irons so as to interfere with the contractor. Revenue from the flatiron is estimated by his company at about 60 cents a month, or $7.20 a year. On new customers they aim to have a solicitor call and put an iron on trial before a customer gets his first bill.

President Brown called attention to the fact that the best prospects for electric irons are among the middle-class of people, who can afford the iron, but who do not have all their work done outside or by hired help.

Mr. Learned, in answer to a question as to the difficulty of persuading a customer to throw out a gas or gasoline engine and put in electric power, cited a case of a customer who had a 30-hp gas engine which had been used for 18 months with satisfaction. One of the proprietors of the concern was working in the shop and kept it in good order. Finally a motor was put in at the company's expense, the consumer paying for the wiring and the rental for the motor on six months' trial. At the end of six months he signed a five years' contract for power and has added to the motor installation since then. In a country town it is a very good practice to put in a motor on trial if the business to be got out of it will justify it. On the trial the customers always pay for the loan of the motor and the wiring. Mr. Smith reported that in Kawanee he had on several occasions put in motors on trial against gasoline engines with success. Mr. Davis, of Litchfield, said he had three places where he had displaced gasoline engines with motors.

Extending Electric Service to Neighboring Towns.

Mr. Edwin O. Brown, of Elmwood, Ill., presented at the recent convention of the Illinois State Electric Association a paper on "Extending Electric Service to Neighboring Towns." Those in responsible charge of the Elmwood electric station perceived that the local field had become quite fully developed as to lighting, and the establishment of a power circuit appeared inadvisable in a community of 2000 population. The matter was then taken up of supplying neighboring communities with electrical service. A canvass was made of Yates City, a town of 1000 population, three miles west. A canvass was made there, a franchise was obtained and a very satisfactory business promptly secured, which has steadily been growing. The time was fortunate, inasmuch as six miles of No. 0 wire, 15 miles of No. 6 wire and other sizes for the work, a carload in all, were bought at 10 cents per pound. A pair of No. 0 wires connected to the switchboard, and through connections independent of Elmwood circuits, take current from either of two alternators. Sixteen series arcs on streets of Yates City are served by a circuit of No. 6 wires, looped in with Elmwood arcs on the same schedule. Both Yates City circuits operate from the station switchboard.

Three years ago a favorable franchise and contracts were made for the supply of Brimfield, a good business was wired in while lines were building, and a satisfactory growth continues. Brimfield lies eight miles northeast of Elmwood and has a population the same as that of Yates City.

While the Brimfield work was in progress, Maquon, nearly the size of Yates City, 12 miles from Elmwood, with Douglas, a hamlet midway between, were looked up. Preliminaries were completed and the work installed the following season, two years ago.

In these extensions the several City Councils and the citizens were, of course, in the main favorable and even enthusiastic. The towns were too small for thought of a home concern to excite antagonism, and the dealings, public and private, with these communities have been entirely free from unfriendly action or factional influence, but tact, diplomacy and push were necessary. Reliance was placed on public-spirited business men or well-known farmers, as to some local detail, who went with a representative of the company through the country to secure right-of-way signatures of all abutting owners to a brief typewritten form in the nature of a quit claim grant for pole-line construction and maintenance. Taking up the matter in a proper way and through right hands, these agreements, covering some 25 miles, were got without cost.

A voltage of 6600 was adopted as being a reasonable pressure and No. 6 hard-drawn bare wire as mechanically good and ample for prospective loads. Stout 25-ft. poles were used, excepting for crossings, with ordinary two-pin cross-arms, bolted. Guy anchors were liberally used and No. 15 "Victor" Locke triple-petticoat glass insulators. Oil-insulated step-up and step-down 30-kw transformers are at either end of each long-distance line, provided with 10 per cent taps, in case loads should grow to cause unequal drop. As yet there is practically no drop, although transformers are fairly well loaded on the peak. These transformers are on roofed platforms adjoining poles, a dozen feet from the ground, with choke coils and lightning arresters, which latter so-called protection is duplicated each two

miles. Four 5-kw transformers along the way between towns step-down and supply each a group of five or six farm residences, each using about his premises 20 to 35 lights and several flatirons. All are on meter at the regular rate of 10 cents per kw-hour, but with a minimum of $2 per month, instead of $1, as for residences in towns.

Elmwood and Yates City streets are lighted by arcs controlled from the station. Brimfield and Maquon have, respectively, 35 and 25 Gem series 40-cp incandescents, operated through regulators, and being within range of the 2000-volt primaries, no series transformers are required. The contracts are on moon schedule until midnight, and designate an employee of the town to wind and set a Hartford eight-day time-switch clock and to replace burned out lamps.

About one-half the high-tension lines are on highways, and half follow the railroad rights-of-way, the poles being set within fences on land of farmers. There is no employee on regular pay in any outside town, but incidental helpers in those towns, somewhat familiar with the work, can usually be in call for fuses of small emergency work. All the towns being on railroads, men go and come with economy and convenience, and a wagon, buggy, saddle and automobile are often used in the service.

Much of this work, though most carefully carried out and apparently profitable, is expensive in proportion to the income, and whether depreciation, renewal, up-keep and operation will show it finally advisable, must remain for some time in question.

DISCUSSION.

Mr. Frank J. Baker, general manager of the North Shore Electric Company, of Chicago, said that if any members intended to follow the plan of getting a franchise in a small town with the intention of reaching another town later, they should have stated clearly the right to transmit through that town to the town beyond; otherwise, unfriendly city officials might question the right. He also commended the use of the word "long-distance" in speaking of transmission lines instead of "high-tension." He advised the securing of street-lighting contracts for as long a term as possible. As to the relative legality of contracts for 5 or 10 years, he said it was equally legal or illegal. Mr. Hess, of Ottawa, said the statutes of the State of Illinois do not permit the making of a contract beyond two years by a city council.

Mr. H. A. Foster, of Fairbury, gave the experience of his company five years ago in building its line five miles from Fairbury to Forrest. At Fairbury a transformer is used to step-up from 1000 to 6000 volts. They have had no trouble with the breaking of insulators, which are common double-petticoat glass. The poles, which are 120 ft. apart, carry No. 8 bare wires. During the five years there have been but two occasions when the town of Forrest was deprived of light. One was due to a break in the line during a sleet storm when service was off a part of one night. The other shut-down was occasioned by a telephone company putting up a line in a dangerous position with reference to the transmission line without his company's knowledge. The coal bill at the Fairbury plant the first month the Forrest load was added was less than $25 more than that for the same month a year previous. This included also an increased load at Fairbury. He estimated that the actual increase in coal bills due to operating Forrest was $150 per year. The revenue from Forrest was $3,200 per year.

Mr. John F. Gilchrist, of Chicago, cited the experience of the plant at Lemont, Ill., which is now operated from the Chicago transmission line of the Economy Light & Power Company at Joliet. This is a town of about 3000 inhabitants which had a small plant capitalized for $20,000. The income was about $6,500, but the company was unable to make a profit as the property was run down. The Economy Company purchased it for $10,000, put in a small substation and all the labor connected with the plant is now done by one man. The amount of power required is insignificant when taken from the large power house. In purchasing the plant of a company in a small town he thought it a good plan to discuss the matter with the council something on this order: "We are offered this property; we feel like buying it, but we want the good will of the council and the people. If there is going to be any hard feeling or any disposition to question this deal we do not want to come in, because we only want to come with the good will of all the people."

In regard to the cost of the Fairbury-Forrest line, Mr. Foster said it was in the neighborhood of $375 per mile. Poles, except at crossings, were 20 ft. long with 7-in. tops. The transmission line was just outside the railway right of way. This figure included only the pole line and not the transformers. Poles were placed on private property by verbal consent. There was no lease. The railway company offered to allow the poles on their right of way for a long period of years on the payment of $6 per year per mile for such occupancy. Attorneys, however, advised that the railroad could not grant a right of way for an electric transmission line, after having condemned a right of way for railway purposes. Whenever the right of way was purchased outright or obtained from the State they had that right.

President Brown said that as far as the Chicago, Burlington & Quincy Railroad was concerned, along which his lines were built, the road was under agreement with the Western Union Telegraph Company to let no one else on the right of way except with the consent of the Western Union Telegraph Company.

Mr. Miller gave some particulars regarding the concrete poles used on the transmission line between Marseilles and Ottawa, Ill. These poles were made at Marseilles and then taken on canal boats to Morris and from Morris to La Salle. They are of square cross-section, 30 ft. long with 6-in. top and 9-in. butt, reinforced with ½-in. square rods of high-carbon steel, 29 ft. long, six rods to the pole. The molds are in three sections, two sides and a bottom, the exposed side being smoothed off by hand. The 30-ft. poles, which weigh about a ton, are allowed to set two days before handling before the molds are taken off, and then left in the yard 21 days before using. In handling, a crane picks them up at the center and, while there is considerable deflection, the poles spring back into shape. On this line they were handled by a canal boat taking them to the place of installation, where they were picked up with a gin pole and set in the ground. A 30-ft. pole with 6-in. top costs about $7.50. These poles are also made up to 50 ft. in length. Fifty-foot poles, which weigh 3.5 tons, are made on the ground where used. They are provided with pole sets. He said that he had witnessed a test in which a pole was deflected 3 ft. from vertical (the base being held rigid) and it sprang back to a perfectly straight pole. Upon being deflected 4 ft. the pole cracked near the bottom.

Mr. H. E. Chubbuck said that the work of setting such a pole 30 ft. in length required about the same machinery and men needed for a 50-ft. wooden pole. On a canal line like this transportation was easy. On a railroad or interurban line they could be handled from a car. For a cross-country line the poles are so heavy that transporting them in a wagon would be difficult, but the gravel, cement and forms could be hauled and a portable mixer run by a gasoline engine could mix at each pole. He thought the poles on a cross-country line could be made for about $10 apiece. It would cost about three times as much to set them as ordinary 30-ft. poles. On the whole, he thought concrete poles for supplying lighting from town to town would be very permanent and reliable. The pole rights should be contracted for. Whenever a pole is put on a man's property there should be a contract to place it there, the company buying and paying for the right. In running 10 miles of transmission line last year this company bought the right at $1.50 to $2 per pole.

Mr. Hyatt, of Chicago Heights, urged the importance, in building such small transmission lines, of providing for additional lines on the same poles to allow for expansion. Mr. Chubbuck said that his syndicate was considering the construction of about 15 miles of line with concrete poles.

INTERIOR WIRING AND ILLUMINATION

Model House in Brooklyn Suburb.

Invitations are now being extended to discriminating people to inspect a rather unusual exhibition of the comforts and beauties possible in a modern home where the conveniences and advantages of electric cooking, laundering, sewing, sweeping, etc., are practically shown by experienced attendants. The "house electrical," as it is called, is a modern dwelling on East Eighteenth Street, Fiske Terrace. Here the Brooklyn Edison Company has provided a complete equipment for domestic electrical service and one of the large department stores of the borough has installed beautiful, novel and homelike furnishings. The house, which is shown in the foreground in Fig. 1, is built to sell for $15,000 and contains 12 rooms. The Brooklyn Edison Company has wired it throughout with base board receptacles on separate meter circuit to demonstrate to builders and others the necessity of installing such circuits for portable devices, chiefly of the heating type, and also to educate the public in the use of such devices in connection with regular electric service. In 10 days over 1400 visitors have inspected the house and in that time and as a direct result of the demonstration, 17 houses already built have been wired for electrical service.

The various rooms are equipped only with such devices as the average householder of moderate means would deem sufficient for his wants. The kitchen is shown in Fig. 2, the bath room in Fig. 3 and a bedroom in Fig. 4. Unfortunately, views of the other rooms could not be obtained in time for this article. The bedrooms are equipped with two-lamp fixtures fitted with turn-down lamps of the Hylo type. In the nursery are a milk warmer and hot-water pot; in the bedrooms are heating pads, foot warmers and curling irons, with the exception of one which also contains a sewing machine and flatiron. The bath room contains a hair drier, curling iron, vibrator, hot-water cup and sterilizer. In the dining room, the sideboard contains a copper set comprising a chafing dish, coffee percolator, stove and kettle. The serving table is equipped with a bread toaster, percolator, chafing dish and fan. A plate warmer and vacuum cleaner are in the pantry and the kitchen has a Simplex stove, coffee mill, urn, cereal cooker, teapot, vegetable boiler, chafing dish, broiler, flatiron, electric heater attached to kitchen boiler, and other cooking utensils. In the laundry in the basement there

FIG. 1.—"HOUSE ELECTRICAL" IN FISKE TERRACE, BROOKLYN.

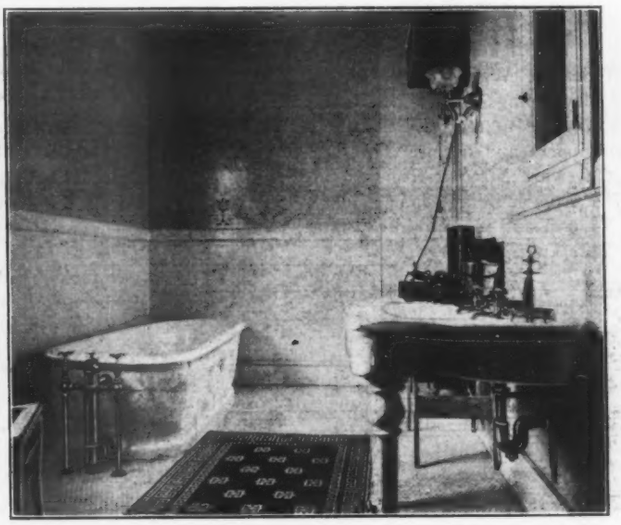


FIG. 3.—BATH ROOM EQUIPPED WITH ELECTRICAL CONVENIENCES.

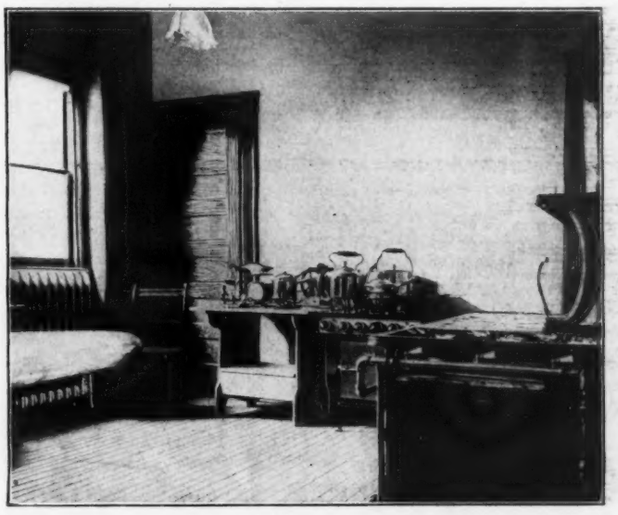


FIG. 2.—KITCHEN IN MODEL HOUSE.

FIG. 4.—BEDROOM AND SEWING ROOM.

are flatirons and a washing machine. The parlor, library and halls are lighted with regulation fixtures in addition to portable lamps. No attempt has been made to overdo things either in the furnishings or decorations or yet in the electrical equipment. The impression left is that electrical service is very convenient and withal not costly, as a portable meter shows how much energy each device uses.

Lighting of the Moore Theater and the New Washington Hotel at Seattle, Wash.

By Louis P. Zimmerman.

THE MOORE THEATER.

The lighting of the recently completed Moore Theater of Seattle, Wash., is a very striking example of the rapidly-developing science of illuminating engineering which is beginning to receive the attention it deserves from the best engineers and architects of the country. Between Virginia and Stewart Streets, fronting on Second Avenue, stands an immense building comprising the $1,500,000 New Washington Hotel and the Moore Theater, each reputed to be one of the best west of Chicago.

The theater occupies the north end of the block facing Virginia Street with an end width of 76 ft. and fronting on Second Avenue for 176 ft. It is six stories high, built of white brick and finished with an ornamental top front. The name, "Moore Theater," is displayed to the downtown districts by a 30-ft. electric sign placed diagonally across the roof of the theater visible to all parts of the city and lighted by 154 incandescent lamps. A smaller street sign facing down Second Avenue bears the name of the attraction at the playhouse. The ticket office is located at the right and the manager's office at the left of the main entrance. The avenue along the front is well lighted with six 5-lamp street standards located at the curb and fitted with ground glass globes giving a sufficient, but not blinding light.

In the general floor plan, shown in Fig. 1, the first 34 ft. along Second Avenue between the ticket office near the entrance to the New Washington Hotel at the other end, is fitted for stores on the first floor and offices and rooms on the floors above. Back of the outer row of offices is the theater proper, divided, on the first floor, into an entrance vestibule in the shape of a 30-ft. octagon immediately inside the main entrance doorway, and below which is the ladies' retiring room; a foyer inside the vestibule, 30 ft. x 50 ft., with a dome-shaped roof, below which is the gentlemen's smoking room of the same size, and the theater proper. A side entrance on Second Avenue opens to the stage, the basement and the office elevators. The framework of the building is entirely steel, covered with concrete below and brick above, making it fireproof, the only wood used in the construction being the stage floor.

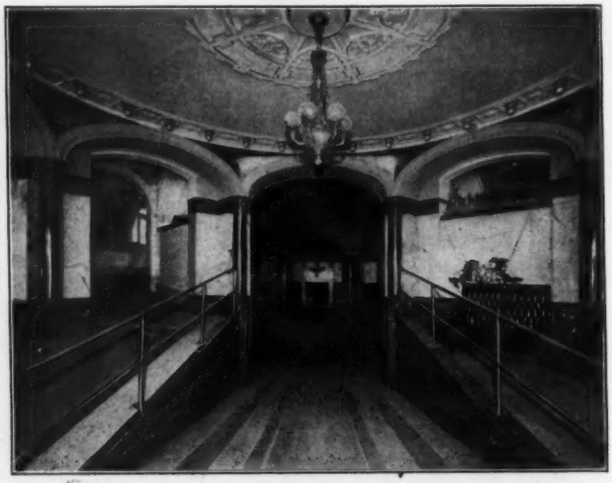


FIG. 2.—ENTRANCE VESTIBULE SHOWING INCLINES.

The auditorium is 72 ft. wide and 75 ft. long, and has a seating capacity of about 2200, of which 728 may be accommodated on the lower floor, 128 in the boxes, 660 in the balcony, and about 700 in the gallery. The stage is 75 ft. from wall to wall, 50 ft. from footlights to the rear wall, and 70 ft. to the fly-gallery, which provides room for almost any scenery. Four dressing rooms for leading actors and actresses are immediately behind the stage, and 12 other dressing rooms are in the basement. The theater is steam-heated, the steam being generated by two 175-hp Geary oil-burning, water-tube boilers. The building is ventilated by a hot-air system controlled by electric thermostats located in various parts of the building and set at the desired temperatures. The temperature is con-

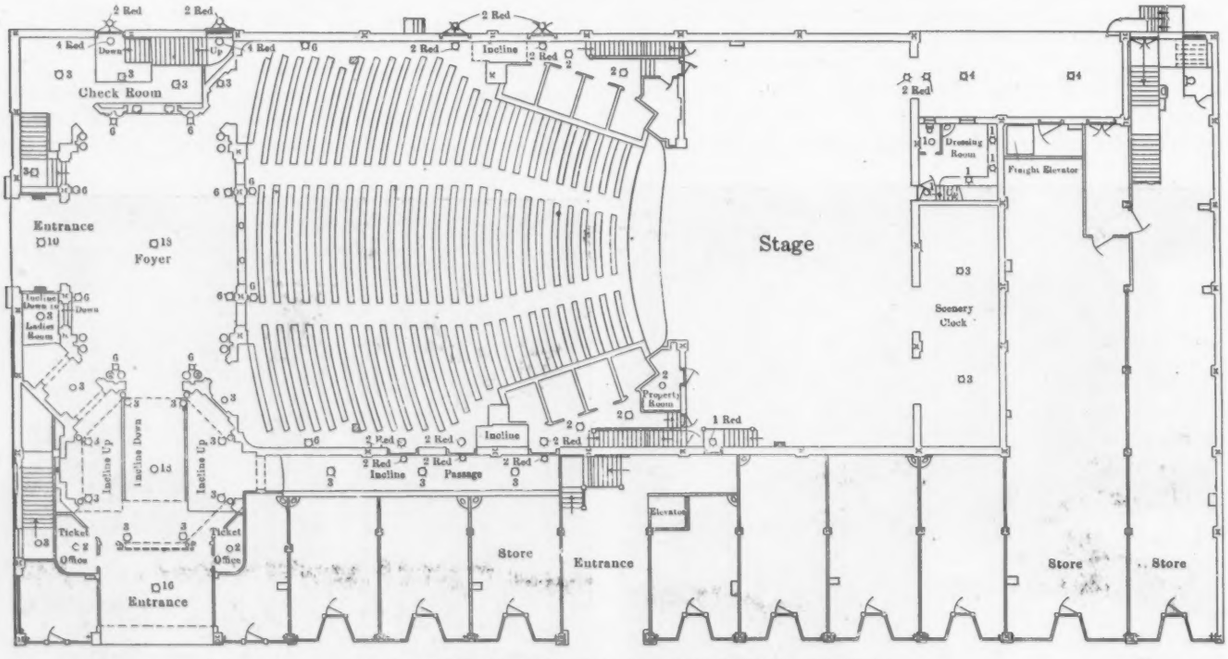


FIG. 1.—GENERAL FLOOR PLAN OF MOORE THEATER, SEATTLE.

trolled automatically by a Johnson Service Company regulator connected to the thermostats and operating a trap-door which controls the amount of air admitted to the ventilator-shaft. The ventilating air is heated by being forced over steam coils by a 120-in. American Blower Company fan driven by a 13-hp Crocker-Wheeler direct-current motor. An automatic fuse sprinkler system covers all parts of the house, stage and base-

FIG. 3.—VIEW FROM STAGE, MOORE THEATER.

ment, and 10 hose-reels are located in accessible parts of the building.

The house and stage circuits are controlled from two marble switchboards located at the right side of the stage and equipped complete by the Agutter-Griswold Company, electrical engineers and contractors of Seattle. All wiring is in iron conduit arranged inside the walls so as to be accessible for repairs and changes at all times. At present all the electrical energy is supplied from the Seattle Electric Company's transformers located in the alley back of the building. Ultimately, generators and engines will be located in the basement of the theater itself. To provide for emergencies, a gas lighting system is installed.

The stage is lighted with five border strips having 60 16-cp lamps in each strip. The footlight has four circuits, each containing 35 lamps; the colors being white, red, blue, and amber. Cutler-Hammer dimmers control all the lamps or each color separately. The paint-bridge is lighted with 50 lamps, and the fly-gallery, scene docks and gridiron have about 60 lamps. The 14 dressing rooms average four lamps each in addition to gas fixtures. In the body of the house from the footlights to the entrance, there are about 2600 lamps, varying in rating from 4 to 34 cp. The front and top signs at the entrance have about 300 lamps which burn every night. The theater complete has about 4400 lamps of various sizes.

Three general methods of lighting are in use in various kinds of buildings depending on their structure and design. One is the arrangement of lamps to modify or strengthen some particular color; another consists of an arrangement to subdue and diffuse the light in general and keep it out of the eyes; and still another rearranges the natural light distribution by means of shades and reflectors. Persons going to a theater go to enjoy themselves, dress in their best clothes, and like to look as well as possible. White light produces a pallor, while a bluish tinge gives a ghastly effect to the fairest complexion. Hence the whole scheme of lighting the body of a theater is based upon the idea of making its patrons look as pretty as possible. The general scheme of color in the Moore Theater is pink and white, and the style is Grecian throughout. There are no bare lamps in the auditorium, all being fitted with ground glass globes to diffuse the light and keep down the intrinsic brilliancy without concealing the source. Inside the main entrance is the octagonal entrance vestibule, whence inclines lead up to the balcony and down to the foyer. These inclines have a grade of 1 to 8, and entirely eliminate stairs and steps in the lower floor and balcony. The vestibule walls consist of arches, supported by marble columns carrying the circular Grecian ceiling, which has a border of 36 lamps set deep into rosettes and covered with ground glass globes. From the center of the dome a chain-design chandelier is suspended carrying six globes concealing the lamps.

The foyer extends up through the mezzanine floor; the entrances to the first floor of the house being along its length. The balcony incline extends entirely around the foyer, with a passage leading to both sides of the house from which entrance to the gallery is obtained by two short inclines. The foyer lamps are in circuit with dimmers when the stage is lighted, so that persons going to the retiring rooms in the basement can do so and cross the foyer without being observed and without disturbing the audience while a play is in progress.

No post supports are used for the balcony or the gallery above it, so that there is a clear, unobstructed view from every seat on both the first floor and the balcony. The boxes are carried out in the octagonal plan of the vestibule, showing five sides of the octagon, and are divided into lower, mezzanine, balcony and dress circle loge. Each box is lighted by lamps hidden behind a stained glass panel in each of the three front sides of the octagon, set flush with the box, and leave the impression that they are a part of the architectural design rather than a method of lighting. The lower boxes are lighted by overhead lamps protected by ground glass globes.

Except for a few torch wall-bracket lamps and lamps under the balcony at the entrance and in the boxes, there are no exposed lamps of any kind and the wall-brackets are out of the range of vision. Beneath the balcony are five inverted colored-glass domes with six 8-cp lamps in each. Along the front of the balcony, which is finished in the same square Grecian effects, are seven receptacles set flush with the outside, covered with green-stained glass and lighted by four lamps each, although the casual observer would hardly notice their presence, so well is the light diffused. Above the gallery are four ceiling lamps and a scroll work circle in the center of the dome, which contains 28 8-cp lamps hidden from view, but so arranged that the light passes through the scroll openings. On

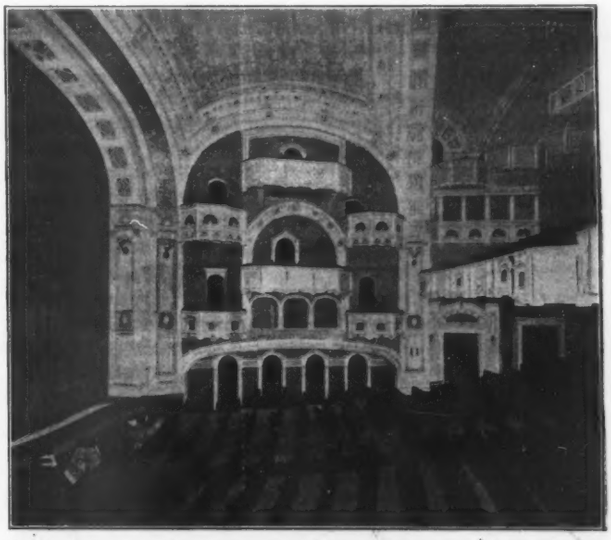


FIG. 4.—VIEW SHOWING BOXES, ARCHES AND BALCONY, MOORE THEATER.

both walls of the gallery the dome windows are designed to represent the setting sun. A group of lamps is placed directly behind a circle of yellow glass illuminating that only and the rays spreading along the lines of the glass give a very pleasing mellow sunset.

The proscenium opening next to the stage is 34 ft. wide and 33 ft. high, with an overhead arch rounded at the corners, lighted by groups of five lamps hidden behind a double scroll

work in the shape of two squares upon each other. The boxes are arranged between the proscenium arch and the main arch, which connects with the balcony rail. The main arch is similar in design and lighting to the proscenium arch. A circular arch and column effect surrounds the boxes on either side. The ceiling above the boxes forms the main reflecting dome. It is built about a central mural painting 20 ft. in diameter, surrounded by a latticed scroll work and illuminated by 24 16-cp lamps. Around this and inside of the outer oblong scroll border are eight oblong windows covered with blue glass behind each of which are two 16-cp lamps, forming the prettiest single illuminating feature in the theater. The outside latticed scroll stands in bold relief by the light of 50 lamps hidden behind it.

FIG. 5.—VIEW OF RECEPTION ROOM AND TOTEM-POLE FIREPLACE.

The interior design is symmetrical and strictly Grecian in every line, with scarcely any exposed fixtures, the lighting being entirely with diffused light, which gives good illumination in every part of the house and preserves all the natural colors of the faces and clothing of its patrons. The theater is owned by Mr. Moore and was built at a cost of $250,000. It was designed by Mr. E. W. Houghton, the Seattle theater architect, and is admitted to be one of the prettiest and most harmonious, as well as the best furnished theater in the West.

FIG. 6.—MAIN CORRIDOR OF NEW WASHINGTON HOTEL.

THE NEW WASHINGTON HOTEL.

The New Washington Hotel built adjacent to the Moore Theater and occupying the corner on Second Avenue and Stewart Street, is built on the site of the old Washington Hotel. The building has 253 guest rooms on the upper 11 floors, all finished alike and giving the guests a superb view of Puget Sound and the nearby mountains. On the first floor is the main dining room, the corridor, the offices, a ladies' reception room, a main reception room, writing room and bar. The dining room, corridor and writing room are all finished in white marble. A double staircase leads to the mezzanine floor, where the orchestra and ladies' reception rooms are located. In the basement are a barber shop and manicuring department, ice machines, kitchen and its accessories complete.

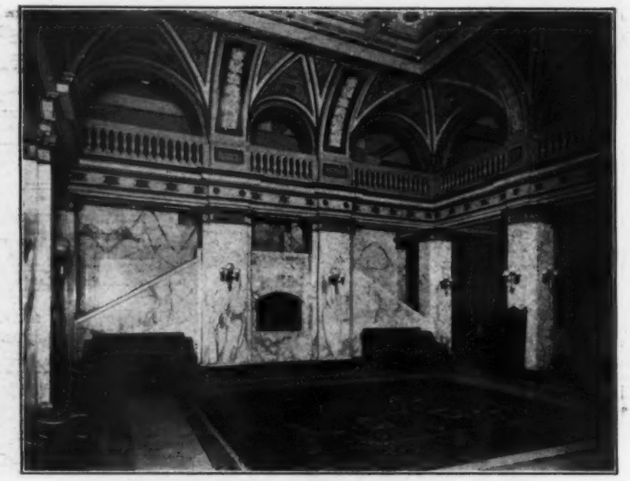


FIG. 7.—DOUBLE STAIRWAY TO MEZZANINE FLOOR.

The building is built of a light-colored brick upon a steel framework and when completed will have a large roof garden on the top. The vacuum heating system is used throughout. Fig. 5 shows the famous fireplace surrounded by the totem-pole design and surmounted with a view of Mt. Ranier, the highest peak in the United States, which is only 40 miles from Seattle and can be seen from the hotel rooms. The style of architecture and the arrangement of the torch wall bracket lamps is well shown in Fig. 6, as well as the marble pillar and post structure.

The double marble stairway, shown in Fig. 7, leading to the mezzanine floor is one of the prettiest pieces of interior construction seen in buildings of this class.

The one criticism upon the lighting is that it is almost tawdry from a superfluous number of lamps. The fact that good lighting can be secured without making the sources too conspicuous has apparently been disregarded. A sign extending over nine floors and displaying the name "New Washington Hotel" is said to be the largest vertical sign west of Chicago.

Letter to the Editors.

The Electromagnetic Gun.

To the Editors of Electrical World:

Sirs:—I have lately been experimenting with what promises to be an electromagnetic gun that will impart to a projectile a higher velocity than any gun now made. By quickly energizing and de-energizing, in rapid succession, several electromagnetic coils or solenoids wound on a brass tube, a plunger placed inside the tube is given a velocity that will carry it quite a distance. It is believed that the results thus far obtained will be of interest to some of your readers.

On a brass tube, about 5 in. in length and 7/32-in. bore, were wound seven coils, each coil averaging 2 cm in length on the tube and having 52 turns of No. 18 copper wire. There were thus 26 turns per centimeter length, and each coil contained about 8 ft. of the wire. These coils were connected to 156 dry

cells in multiple-series of six cells in a group and 26 groups in series. The cells are stamped by the makers to give 1.4 volts on open circuit and from 14 amp to 18 amp on short-circuit; the battery should give 36.5 volts on open circuit and 100 amp on short-circuit. The average length of travel through air of the lines of force in each coil, when it was energized, was 6 cm. The only iron used in the magnetic circuit was the plunger itself.

The plunger was 3/16 in. in diameter and 1 in. long and weighed 0.008 lb. It traveled 80 ft. in one-half second, the velocity being determined in the following manner: When the tube was placed horizontally the plunger was found to drop 4 ft. in traveling 80 ft., so that 0.5 second must have been consumed in traveling 80 ft. through the air. There being considerable air resistance, because the plunger revolved end over end, it can safely be said that the velocity as the plunger left the tube was 200 ft. per second. The tube was nearly 0.5 ft. long, so that the force was acting on the plunger apparently for 0.005 second. Each coil was connected and disconnected separately. There seems to be more force imparted to the plunger at the break than at the make of the circuit.

By making a tube 16 times as long as the one described above and using 16 times as many similar coils and employing the same battery, the same force applied above will act for $\sqrt{16} = 4$ times the length of time as formerly, and should produce four times the former velocity. That is, instead of 200 ft. per second the velocity should be 800 ft. per second. It would seem, therefore, that a tube 80 in. in length will project a plunger with a muzzle velocity of 800 ft. per second.

Since the current is in the coils for only a small fraction of a second, the heat effect is very small. For instance, the tube described above can be energized for about 50 times before the coils feel the least bit warm to the hand. Hence, a larger current could be used without danger of overheating the coils.

In the first arrangement used by the writer the projectile carried brushes which would automatically connect in circuit sections of the winding so as to produce a constant pull on the projectile as it passed through the gun barrel. However, this arrangement was not successful. The best results were obtained by making and breaking the circuit through several separate and distinct coils with a mechanism operated outside of the gun proper. When energizing and de-energizing the coils suddenly the force on the plunger seems to act like a hammer blow, the arrangement being such that the circuit is opened as soon as the lines of force have imparted energy to the projectile.

Experiments showed that the range of the projectile varied directly with the number of cells of battery placed in series, the length of the tube remaining the same. By increasing the length of the tube and increasing the number of lines of force it is possible greatly to increase the velocity of the projectile. Even with a tube less than 5 in. in length and a moderate magnetic density, a velocity of 200 ft. per second is reached. It is the writer's intention to construct a gun 48 in. in length and he confidently expects to obtain a velocity of between 1500 ft. and 2000 ft. per second by using a high-voltage battery and larger current.

LAREDO, TEX. SAM. T. FOSTER, JR.

[On account of the weight of an electromagnetic gun, it would necessarily be of the stationary type. Therefore, the principles involved will be applied to the case of a 6-in. sea-coast gun of the 1905 model. The projectile in this gun has a weight of 106 lb., a travel of 256 in. within the bore, and leaves the muzzle with a velocity of 2900 ft. per second. The kinetic energy stored in the moving projectile as it starts its free flight is, therefore, 13,875,000 ft.-pounds. This energy is acquired during 0.014 second, the time of travel within the bore. Thus the average rate of acquisition of energy is 970,000,000 ft.-pounds per second. The average power during this small interval of time is, therefore, 1,750,000 hp. It is thus evident that for the operation of a single 6-in. gun of modern type there would be required a generating station capable of supplying energy at the instantaneous rate of 1,750,000 hp, or about 1,360,000 kw—a value equal to more than one-third of the total available power of Niagara Falls. Of course, the generating apparatus could be greatly overloaded for such a short period, though the power factor and efficiency would then necessarily be correspondingly low; neglecting these latter factors and making a generous overload allowance, the rating of the necessary power-house equipment for a modern 6-in. gun would be, say, 500,000 kv-amp. One appears, therefore, justified in concluding that the operation of a gun electromagnetically is commercially quite impracticable.

Furthermore, certain serious technical limitations would be encountered in the design of an electromagnetic gun. In the case cited above, the acceleration within the gun is 207,000 ft. per second per second. Since the weight of the moving mass is 106 lb., the required accelerating force is 683,000 lb. The maximum area over which the accelerating force would be exerted is 28 sq. in., so that the minimum force is 24,300 lb. per sq. in., or 1700 kg per sq. cm. In order to produce this force magnetically the minimum flux density would have to be 200,000 lines per sq. cm. The impossibility of employing such a density will be appreciated when it is recalled that soft iron is well saturated at 10,000 lines per sq. cm. If use were made of the latter density, and with it sufficient rapidity of magnetization could be secured for operating a gun, the acceleration would be only 500 ft. per second per second, instead of 207,000 ft. per second per second required to give the muzzle velocity of 2900 ft. per second. The cast-iron gun of past ages with the powder factory as a source of energy would be decidedly cheaper, more convenient and much more deadly than the electromagnetic gun with its colossal electric power house adjunct.—EDS.]

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Split-Pole Converter.—C. P. STEINMETZ.—The second part of his theoretical paper on variable-ratio converters. The author discusses the method of obtaining a variable ratio by change of wave shape of the Y-voltage. He then discusses armature reaction, commutation and magnetic density. The paper is to be continued.—*Gen. Elec. Rev.*, December.

Frequency Converters.—E. PFIFFNER.—To connect together two systems of different frequencies, frequency-converters may be used consisting either of two synchronous machines or of a synchronous machine and an induction machine or of two non-synchronous machines. The author discusses the relative advantages and disadvantages of these different systems and finds that in general the non-synchronous machines are less sensitive than the synchronous machines with respect to variation of frequency and differences of regulation in the two networks.—*Schweiz. Elek. Zeit.*, Aug. 22 and 29, Sept. 5; *L'Industrie Elec.*, Nov. 10.

Additional Iron Losses in Induction Motors.—O. S. BRAGSTAD AND A. FRAENCKEL.—The conclusion of their illustrated paper, the first part of which was abstracted in the Digest last week. The cause of the "additional losses" is discussed, and methods for measuring them are described. Finally, a formula is given for calculating the loss in the teeth and this formula is applied in some examples.—*Elek. Zeit.*, Nov. 12.

Testing of Alternators.—S. P. SMITH.—An abstract of an illustrated paper read before the Birmingham section of the (Brit.) Inst. Elec. Eng. After showing the sources of failure and incorrectness of the existing methods of testing alternators on short-circuit, the author proceeds to expound a method

whereby the actual full-load conditions can be exactly imitated by supplying the total losses, and the accurate temperature rise and efficiency can thus be obtained.—Lond. *Electrician*, Nov. 13.

Direct-Current Generator.—An illustrated description of a construction of two 800-kw, slow-speed, double-flywheel generators at the Rombach Steel Works, in Germany. The construction is shown in Fig. 1. Each generator consists of two

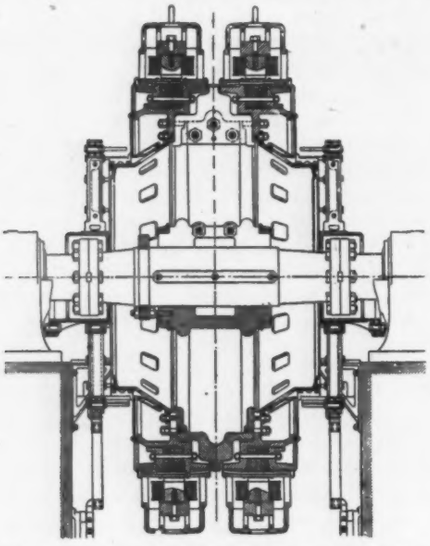


FIG. 1.—SECTION OF DIRECT-CURRENT GENERATOR.

armatures mounted on a common spider by means of a double row of arms, and two separate field magnet systems. The complete machine is mounted in the middle of the shaft of a four-cylinder gas engine, with two cylinders working in tandem on either side of the generator. The gas engine is rated at 1200 hp, and has a speed of 120 r.p.m.; each half of the generator is rated at 400 kw. The machines generate at from 230 to 350 volts per armature. Each armature is provided with a series-parallel winding for five circuits and 20 poles, and equipotential connections, the position of which on the commutator sleeve can be seen in the illustration, are also provided. The drawing also shows the manner in which the unusually long commutator lugs are supported by means of an insulating ring fixed to a projection of the armature frame. Wrought-iron pole pieces of oval shape are bolted onto the cast-iron yoke, which is bell-shaped to give great rigidity. The brush-rockers are supported on castings surrounding the couplings and fixed to the main bearings.—Lond. *Elec. Eng'ing*, Nov. 12.

Lamps and Lighting.

Metallic-Filament Lamps in Great Britain.—A review of the different metallic-filament lamps now being made in Great Britain. The British Thomson-Houston lamp can be used with direct or alternating current and in any position. The specific consumption is 1.25 watts per candle-power and the life 1000 hours. Since the lamp cannot be made for e.m.fs. above 125 volts, two or more lamps in series must be used for higher voltages. Such lamps are marked with a series number and "no two lamps differing in series number by more than two should be used together." The "Metalik" lamp is made for e.m.fs. up to 250 volts and 50 cp. The low-voltage lamp, suitable for e.m.fs. not exceeding 70 volts, is made in sizes as low as 16 cp. The "Premier" lamp has a life of 1000 hours, while the power consumption claimed is 1 watt per candle-power. They can be used in any position with direct and alternating current. The "Meta" lamp is made in candle-powers down to 25 cp and e.m.fs. up to 250 volts, and can be used in any position. For the "Gral" lamp a consumption of 1 watt per candle-power is claimed. "The consumption is higher for a lamp at the beginning of its life and it has been found that a much better life is obtained by proportioning the lamp to have a consumption of, say, 1.1 watts per candle-power at the outset, the consumption decreasing to 1 watt per candle-power, than to aim at the lower figure in the first case." A feature of this lamp is the method of supporting the filament by platinum spring hooks, which provide a very elastic suspension. The "Gral" lamp is made in candle-powers as low as 20 cp for 100 volts and 40 cp for 200 volts. The "Adnil" lamp has a life of 1000 hours and consumes 1.25 watts per candle-power. Premature blackening of the globe is prevented by the employment of a mysterious white deposit on the central glass stem. The "Sirius-Efesca" tungsten lamp is made for e.m.fs. up to 130 volts and is claimed to have "a long life, frequently as long as 2000 hours." In the "Solium" lamp, or the "metallic lamp with the little safety spring," the expansion of the filament when heated is taken up by a small spiral spring enclosed in the central support which in this case is a glass tube. By this means, it is claimed, the filament is always kept at the same mechanical tension, whatever its position or temperature, with the result that "a good deal of extra solidity is imparted to the lamp." The spring is particularly useful in absorbing vibration. The lamp operates equally well on direct and alternating currents, has the usual consumption of about 1.2 watts per candle-power and can be supplied suitable for use on circuits whose e.m.f. does not exceed 260 volts. The "Sunbeam" tungsten lamp is suitable for e.m.fs. from 25 to 250 volts and for candle-powers from 8 to 100 cp. The "J. S." tungsten lamp consumes 1.1 watt per candle-power, although this lamp is also being made for 100 volts, the specialty is the 25-volt lamp.—Lond. *Electrician*, Nov. 13.

Metallic-Filament Lamps for Street Lighting.—Notes on the results obtained in various British cities with various metallic-filament lamps. In one London district the following results were obtained with osram and tantalum lamps. Of the former 168 and of the latter 848 are installed, making a total of 1016. At the end of 1200 hours, 84 of the original osram and 285 of the original tantalum lamps were still in use; that is, 50 per cent of the original osram lamps and 33 1/3 per cent of the original tantalum lamps were still in working order. The former lamps cost 2s. 11½d. each and the latter 1s. 10¼d. each, so that the difference in the actual cost of renewals, when the average life is considered, is slight, while the consumption of the tantalum lamp is 40 watts and that of the osram lamp 28 watts for equivalent candle-power. In another London district carbon lamps for street lighting have been replaced by osram lamps. Formerly, a double bracket had two 16-cp carbon lamps, now there is one 50-cp osram; consequently, while the number of posts has been kept the same and the light has increased 50 per cent, yet the number of lamps has been halved, and the number of failures decreased—a point often overlooked. The average life to-day is 1019 hours, but lamps recently purchased give a much longer average than this. The cost of lamp renewals per post is 10s. 11d., and the kw-hours used per post per annum is 210. With the carbon-filament lamp, the average life was 703 hours and the cost of lamp renewals per post was 3s. 8d. The units per post were then 490; for equal candle-power 770 units would have been required. They are, therefore, supplying for the same candle-power 560 kw-hours less per annum, and with an increase of 7s. 3d. per annum in lamp renewals. In Canterbury the use of 92 osram lamps shows an average life of at least 1847 hours. At Horsham tantalum lamps have given a life of over 1000 hours. At Swindon, tantalum lamps have been in use since November, 1905. About 500 lamps have been used and have had an average life of 715 hours. At Penarth about 250 metallic-filament lamps are used for street lighting, the majority being tantalum lamps used in series, though series burning and high-voltage tungsten lamps are also employed. The life of tungsten lamps is found exceedingly high, some of the series-operating lamps having reached a life of 3600 hours. Some of the high-voltage lamps have been on circuit as long as 2000 hours.—Lond. *Electrician*, Nov. 13.

Tungsten Filament.—A note on a recent British patent (5387) of Bloxam (Siemens & Halske Company), for a process of drawing filaments from a non-ductile metal like tungsten, a

compound filament, consisting of an internal core of tungsten or other non-ductile metal, surrounded by a skin of ductile metal, is drawn down to the required diameter, extended on the supporting frame and fixed to the leading-in wires. The whole is then inserted into the lamp bulb, and the bulb is connected to the exhaust pump. By raising the filament to incandescence the volatile outer skin is distilled off and only the tungsten core remains.—Lond. *Elec. Eng'ing,* Nov. 12.

Arc Lamps.—A review of recent developments of commercial arc lamps in Great Britain. While a large business is being done with open and enclosed arc lamps, the flame arc is now first favorite, at any rate for street purposes, and is largely coming into vogue for industrial service. The Westinghouse Company has discarded the original Bremer lamp in favor of a simpler arrangement. It will shortly put a magazine lamp on the market. Another magazine lamp is the "Oriflame." Despite the fact that the changing of the electrodes in this lamp occupies from 15 to 20 seconds, during which time the lamp is extinguished, "it is to be found lighting the principal thoroughfares in many large towns, and from the makers' statements is giving every satisfaction." The lamp has the further advantage of using cheap electrodes, while the feature of the magazine makes it possible to fill up the lamp at any time irrespective of the number of electrodes remaining. In the Gilbert multiple carbon lamp the electrodes are so arranged that after the arc has been in use for some time across one pair it changes over automatically to another pair which has not previously been in circuit. This action proceeds over the six pairs of carbon electrodes in the lamp, and then the controlling mechanism feeds all of the electrodes down again, when the same cycle of operation is repeated. The lamp has the advantage of extremely simple construction and long burning life, though unlike the ordinary magazine pattern, when the lamp is trimmed all the electrodes must be renewed at one time. The "Sunrae" lamp is of the gravity-feed pattern, each pole of the circuit being provided with a pair of converging electrodes, the tips of which burn away and automatically descend, keeping a constant length during the operation of the lamp. The control mechanism merely regulates the length of the arc. In the construction of the lamp, guide tubes and flexibles have been avoided, so as to minimize all risk of failure due to the intrusion of dust and dirt. The "Reason" lamp is another flame pattern, from which clockwork is omitted, the control of the arc being effected by a special lever mechanism, "which seems to work satisfactorily."

The "Excello" pattern of lamp is one in which clockwork is employed, but "judging from the enormous number of these lamps in use, its employment would appear to be rather an advantage than otherwise." In the alternating-current pattern of "Excello" lamps a small induction motor, which controls the burning, is extremely sensitive in its movements at all times. Various other British companies also make magazine lamps.—Lond. *Electrician,* Nov. 13.

Multiple-Electrode Flame-Arc Lamp.—A note on a British patent (23,148) of Johnson & Phillips and C. F. Tubbs for a flame-arc lamp with two or more pairs of electrodes in use simultaneously. The arcs are arranged in series, and the upper electrode, which rests on tops, are fed forward by gravity. Each electrode holder is suspended by means of a flexible cord over a pulley, and the separate pulleys are mounted on rocking frames which are linked together by an equalizing device to compensate for unequal consumption of the electrodes.—Lond. *Elec. Eng'ing,* Nov. 12.

Fittings.—An illustrated description of some new fittings especially made for metallic-filament lamps, including reflectors, holophane globes, etc.—Lond. *Electrician,* Nov. 13.

Generation, Transmission and Distribution.

Brass and Copper Rolling Mills.—C. A. ABLETT.—An abstract of a paper read before the Birmingham Association of Mechanical Engineers on the advantages of electrically driven brass and copper rolling mills. With regard to saving in space, the author stated that assuming the supply to be obtained from the Corporation high-tension mains, the saving in area for a 500-hp plant would amount to 2000 sq. ft. if electricity be used in place of steam, and that such space could be used for 8 or 10 additional rolls. An increased output of 20 per cent was mentioned as being the result obtained by the introduction of electric motors owing to the steady and uniform speed obtained. In order to check the power used by a mill, it was recommended that an indicating wattmeter, calibrated in horsepower, should be supplied with each motor, as well as a watt-hour meter for all large motors and separate departments. In this way careful records can be kept of the kw-hours required per ton rolled. For the conditions of Birmingham, where energy is obtained from 5000-volt mains, the author recommends the use of motors of 100 hp and upward to be run directly from the 5000-volt mains with water rheostats for starting. The rules of the supply company require that the fluctuation of current should not be more than 25 amp, corresponding to about 250 hp in power. It is recommended to use a flywheel, the necessary change of speed being obtained by means of a resistance in the rotor circuit automatically inserted as the current increases. In the discussion it was stated that 4000 hp of rolling-mill motors would be connected to the mains of the Birmingham supply system by the end of the present year.—Lond. *Elec. Eng'ing,* Nov. 12.

British Aluminum Plant.—An illustrated description of a new aluminum plant in North Wales. Continuous current for the electric furnaces is derived partly from a 4000-kw water-power plant in the works driven by Pelton wheels and utilizing the waters of neighboring lakes, which render a fall of 1000 ft. available, and partly from motor-generators receiving energy through a 20,000-volt, three-phase transmission line, 13 miles in length from the water-power generating station of the North Wales Power & Traction Company. The machine room contains four water-wheels, each being connected with two 500-kw generators. The two machines of each set are connected permanently in parallel; the total output per set is 8000 amp at e.m.fs. varying up to 125 volts. The aluminum cells are arranged in groups of 25 connected in series and each group is supplied with a current of 7500 amp. When working at full power, each water-driven machine will run one group of 25 cells with a pressure of from 120 to 130 volts. The total output of the works will be five tons of aluminum per day.—Lond. *Elec. Eng'ing,* Nov. 12.

French Power Plant.—The three cities of Lille, Roubaix and Tourcoing, which are connected together by a boulevard, have industries consuming between 150,000 hp and 200,000 hp. Formerly there were separate power stations, but are now supplied with electrical energy from a common plant at Wasquehal. This plant was opened at the end of 1907, and has proved so successful that the intention is to enlarge it. It is a steam turbo-alternator station. There are two turbo-alternators of 1800 kw and two other units of 3500 kw. Three-phase currents are generated at 10,000 volts. Energy is transmitted partly by overhead lines and partly by cables.—*L'Industrie Elec.,* Nov. 10.

Energy of Steam.—J. W. KIRKLAND.—The first part of a theoretical discussion of the energy obtainable from steam. The author first deals with the heat contained in steam and then discusses the phenomena of the expansion of steam.—*Gen. Elec. Rev.,* December.

Traction.

Tramway Brakes.—A full report of the committee on tramway brakes appointed by the (Brit.) Tramways and Light Railways Association. The report is based on information received from a great number of companies using different kinds of brakes. The following remarks are made: The wheel and rheostatic brakes are the simplest and cheapest. They may be relied upon for "retardations up to 3 ft. per second" with average rail conditions and moderate speeds. For cars not exceeding 10 tons in weight, manual application is suitable for wheel brakes. The rheostatic brake has the advantage of utilizing the whole available wheel adhesion independently of speed within the limit of "flashing." The two brakes named are fair alternatives for each other. The retardation stated is suitable for service stops, but is not sufficient for working on heavy

gradients or making emergency stops from high speeds. On clean rails or with the assistance of sand, greater retardation can be reckoned on, but to make full use of it, especially with heavy cars and high speeds, the time of application of wheel brakes must be minimized by the use of power. The "run-back" use of the rheostatic, or rather short-circuit, brake is a valuable device where moderate or severe gradients are worked over. Regenerative control considered as a braking device is equivalent to the rheostatic brake with the addition of definite speed control between certain limits. The slipper brake with wooden blocks is especially suitable for controlling speed on severe gradients. With manual application it is not sufficiently rapid in action, and is also too exacting on the driver to be used as a service or emergency brake. With power applications it becomes a good emergency brake, and only the rapid wear of the wooden blocks is against its use for service purposes. With iron blocks there is little or no advantage in utilizing the weight of the car on slippers instead of on the wheels. The skid brake is a pure emergency appliance, and must be considered as a special addition to the normal braking equipment to meet special risks. The magnetic track brake applied to the rail head has the advantage of rapid and easy application, but it does not afford a great addition to the braking force which is obtainable from wheel brakes under given conditions of rail. It is, in effect, a rheostatic brake of increased force, and may take its place under moderate conditions of service when quicker stopping seems desirable. The magnetic track brake with auxiliary blocks applied to the wheels is an extremely powerful brake, capable of giving "retardations up to 9 ft. per second per second," and, therefore, is especially suitable where the service demands high speeds with frequent stops amid thick traffic. The magnetic track brake with auxiliary blocks applied to the rail-head is at present in a somewhat experimental state, and is evidently capable of further development, especially in the direction of utilizing blocks having a higher coefficient of friction against the rail than the magnetized blocks. Among the general conclusions are the following: All cars should be fitted with two brakes. Where quick and frequent stops are necessary (the usual conditions of urban lines), one of these should be a power brake. Where traffic is light and the maximum speed is low, both types may be manually applied, but where steep gradients exist, only one of these should be dependent on wheel adhesion. The combination of wheel and slipper brakes, accompanied with a regulation for a compulsory stop for the application of slipper brake before descent of a severe gradient, meets this condition. The force of all brakes being dependent upon the condition of the rail, the sanding apparatus should be kept clean and filled with sand. There should be two sand boxes at each end of the car. Curved sand pipes should be avoided. The sand should be sharp, clean and dry.—Lond. *Electrician*, Nov. 13; Lond. *Elec. Eng'ing*, Nov. 12.

Energy Required for Traction.—W. Conrad.—A description of a simple graphical method by means of which the energy required for traction per ton-mile of load can be quickly found if the profile of the road is known.—*L'Industrie Elec.*, Nov. 10.

Installations, Systems and Appliances.

Proposed Gas and Electricity Tax in Germany—The proposed bill for a tax on electric energy and gas in Germany. For electric energy to be sold to others the tax is 5 per cent of the selling price, but not more than 0.1 cent per kw-hour. For electrical energy used for the own needs of the producer 0.1 cent is charged per kw-hour, but this tax is reduced to 5 per cent of the cost, if it can be shown by exact methods of bookkeeping that 0.1 cent per kw-hour is more than 5 per cent of the generating cost. For gas a tax of 0.1 cent is charged per cubic-meter. For lighting an extra tax is charged for each lamp, namely 1.25 cents for every incandescent lamp below 15 watts; 2.5 cents for every lamp between 15 and 25 watts; 5 cents for every lamp between 25 and 60 watts; 7.5 cents for every lamp between 60 and 100 watts; 12.5 cents for every lamp above 100 watts. For incandescent mantles of incandescent gas lamps 2.5 cents are charged per mantle; for arc-lamp carbons, 25 cents per kilogram; for mercury-vapor lamps, 25 cents for every lamp up to 100 watts, and an additional 25 cents for every 100 watts more. In the supplementary notes in which the proposed law is recommended a great many statistical data are given on the development of central stations, on the cost of generation of energy and the production of gas, etc.—*Elek. Zeit.*, Nov. 12.

Substation Relays for Incoming Transmission Lines.—P. MacGahan.—If a substation is fed with energy from a generating station by means of parallel transmission lines, it is important to cut out automatically a line which develops a ground or short-circuit, without interrupting service over the other lines. To disconect the defective line at the transmitting end ordinary overload relays are used with an inverse-time-element to trip the circuit-breakers when an overload occurs. The ground or short-circuit will continue to receive energy from the substation busbars, as shown in Fig. 2, in which Aa' is the defective polyphase line, short-circuited or grounded at G, and Bb' the clear line. It is evident that the direction of flow of energy in one or more of the phases is in the reverse direction at the point a'. The main problem, therefore, is to design satisfactory reverse power relays to be installed at points a' and b'. As a short-circuit may cause the voltage to drop to an exceedingly low value, relays for this purpose must be operative at these low voltages, as well as at the low power factors which may also be caused by the break-down. Moreover, the action under such condition should be practically instantaneous, so that the synchronous machine will remain in operation. Because they would not fulfill the latter requirements, no success was obtained with the first devices used, namely, wattmeters equipped with contacts which would be closed by the action of the wattmeter coils when the direction of power was reversed, thus tripping the circuit-breakers. F. Conrad made an improvement in the windings of the wattmeter-type relay by means of which the relay became operative on zero voltage or on zero power factor. The design consisted of a polyphase-wattmeter movement with coils arranged so as to produce torques being opposed by a torque proportional to the watts. The mechanical construction of the induction watt-hour meter was used, but instead of driving the usual registering dial, the

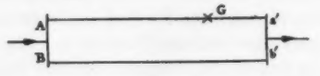


FIG. 2.—DIAGRAM OF SHORT-CIRCUITED AND CLEAR LINE.

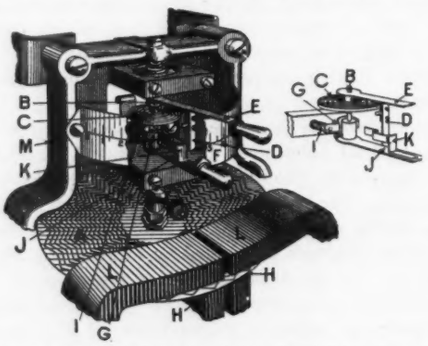


FIG. 3.—VIEW SHOWING CONSTRUCTION OF RELAY.

shaft was controlled by a spring, and a moving arm was arranged to close the contact. The motion of the disk was damped by means of permanent magnets. In its present form this relay is made in single-phase units. In Fig. 3 *A* represents the aluminum disk of the relay attached to shaft *B*. *C* is a spiral control spring attached at its inner end to the shaft *B* and at the outer end to an arm *D*, which terminates in an adjustable index arm *E*, movable over a gradual scale *F*. *G* is a contact arm attached to the shaft *B*. The arm *G* terminates in a contact which in its travel engages the stationary in-

sulated contact *I*, thereby completing the trip circuit. The spring, in addition to controlling the movement of the relay, serves to carry the tripping current into the movable contact. With both voltage and current applied to the relay, its action is selective, the operation on reversal of the power occurring at lower values than under the normal power condition. With voltage alone applied to the relay, it is still operative, but to a lesser degree due to the interaction of *C* and *E*, Fig. 4, *a* and *b*. With only current applied, the coil *C* acts as a secondary to *D*, energizes *E* and thereby creates an operating torque condi-

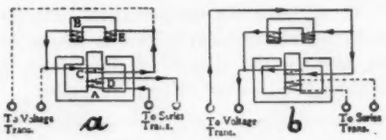


FIG. 4.—DIAGRAM OF RELAY CIRCUITS AND CONNECTIONS.

tion. An external series resistance is interposed between the voltage binding posts and the voltage transformer. The current path, due to current alone, is shown in diagram *a*, the connections being the same as is used in induction ammeters. The current path due to voltage alone is shown in diagram *b*. There is sufficient torque developed in this circuit to give a deflection at full voltage of one-fourth that due to full current alone. The current paths which develop torque proportional to the true watts will be apparent if the coil *C* is considered as open-circuited, the remaining connections being theoretically the same as in wattmeters. To protect two parallel transmission lines it is evident that the form of relay described, if installed at the receiving end, will afford protection under all conditions of low voltage or low power factor. If, however, the fault is such as to reduce the voltage to approximately zero, elements of the relays on both the incoming lines will be approximately the same, and therefore both breakers will trip, interrupting the continuity of service. The limiting value of the voltage required is about 50 per cent of normal; below this the difference between the time-elements is less than the time required for the electrically operated switches to act, so that selective action would not take place. On systems subject to accidental conditions which would produce a reversal of power at very low voltage, and when continuity of service must be maintained, recourse may be had to an additional selective device, the function of which would be to open the trip circuit of each relay instantaneously when the power is in the positive direction, thus preventing the main relay from completing the

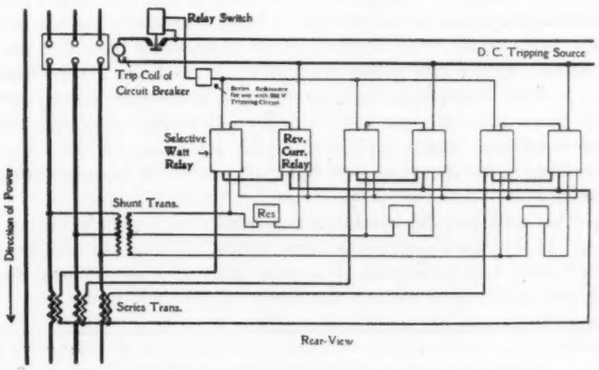


FIG. 5.—DIAGRAM OF CONNECTIONS FOR RELAY CIRCUITS.

trip circuit when it makes contact. This selective device is an ordinary contact-making wattmeter-type relay with the contacts adjusted so that at zero power its contacts are closed, but the control force is so slight that the contacts will be opened when the watts are five or more in the positive direction, the full-load rating of the coils being 5 amp at 100 volts, or 500 watts. Thus, when a short-circuit occurs just outside of the receiving station, the voltage being barely sufficient to cause a destructive current, a voltage of 1 per cent of normal at full-load current would be sufficient to operate the selective device. A complete diagram of connections for the relay circuits is shown in Fig. 5. An elaborate series of tests of these relays, recently made at Syracuse on the transmission lines from Niagara Falls, has given satisfactory results.—*Elec. Jour.*, November.

Switchboard.—S. W. MAUGER.—An illustrated article in which the author first gives rules on the installation of a switchboard and for its operation.—*Gen. Elec. Rev.*, December.

Wires, Wiring and Conduits.

Fuse.—An illustrated description of a new form of "magazine" fuse which enables a circuit to be re-fused four times by merely turning a milled head at the bottom of the case.—Lond. *Elec. Eng'ing*, Nov. 12.

Electrophysics and Magnetism.

Measuring Iron Losses in Bundles of Straight Strips.—R. BEATTIE.—One method in which a wattmeter may be used to measure the losses in a straight test piece is to connect the current coil of the instrument in series with the magnetizing solenoid and the pressure coil to a separate secondary wound round the center of the test piece. This method is satisfactory when the test piece is long and thin. The author investigates whether the method holds good for fairly short test pieces. In this case the real difficulty lies in determining exactly what the instrument measures. If the resultant magnetizing force at the center of the test piece were at every instant proportional to, and in phase with, the magnetizing current, then the wattmeter would measure the true loss per cubic centimeter there. But this is not the case. Owing to end effects, the resultant magnetizing force is neither proportional to, nor in phase with, the current. The author proves that nevertheless this method measures accurately the true specific loss, if proportionality exists between the demagnetizing force (due to the free magnetism at the ends of the specimen) and the induction at the center of the test piece. Tests made by the author are described which show that this proportionality exists and some practical rules are given on the application of the method.—Lond. *Electrician*, Nov. 6.

Positive Ions.—O. W. RICHARDSON.—An account of an experimental investigation of the specific charge (electric charge per unit of mass) of ions emitted by hot bodies. The constitution or material structure of the positive ions given out by hot bodies is a matter of great interest. It is a significant fact that the mean corrected ratio of the mass to that of the hydrogen atom is so nearly the same for the ions emitted from carbon, platinum and iron. It is difficult to say what the ions are, but the investigations of the author seem to show that they are not atoms of the metal, nor atoms or molecules of absorbed hydrogen, nor the positive electrons which Thomson has found in the canal rays and which other physicists have suggested the alpha rays might be. It is possible that the ions arise from some impurity which is common to all of the materials which have been examined. The most likely one to occur would appear to be sodium or its salts, and if positively charged sodium atoms were emitted they would furnish a value of e/m sufficiently near to that which has been observed.—*Phil. Mag.*, November.

Vacuum-Tube Model for Demonstrating the Propagation of Alternating Currents in Cables.—C. V. DRYSDALE.—As is well known, the propagation of electric waves along conductors can be conveniently shown on a small scale by means of a helix fed from a suitable source of high-frequency, high-potential oscillations. In this case the helix is found to glow with brush discharges at the antinodes of potential, remaining dark at the nodes. The glow is, however, very faint. If a long vacuum-tube is laid parallel to the helix, light and dark portions are observed, but these do not coincide with the points of maximum and minimum potential, respectively. The brightness of the tube is proportional to the current in the helix, and therefore the whole distribution of current and potential can be exhibited by vacuum tubes parallel to and perpendicular to the helix, respectively. The author describes a model which shows these effects with greatest convenience.—*Phil. Mag.*, November.

Volta Effect.—J. K. ROBERTSON.—An illustrated paper on the

charges gained by insulated metallic conductors surrounded by other conductors and the relation of these charges to the Volta effect. From the investigation of the author it follows that the manner in which insulated metallic cylinders surrounded by others joined to earth, or insulated plates of metal placed close to others of the same or different metals, become electrically charged, is both complex and obscure. Both the Volta effect and secondary radiation are influences affecting the process of charging, and although the experiments of the present investigation threw considerable light on the relative influence of these two factors, it will be necessary to make more extensive observations before a complete explanation can be offered.—*Phys. Rev.*, November.

Luminescence.—E. L. Nichols and E. Merritt.—A paper in which the authors discuss the theory of phosphorescence from the standpoint of hypothesis that the effect of light, or of other exciting agents, is to produce electrolytic dissociation of the dissolved active substance, and that the light emitted during luminescence is to be explained as the result of the molecular vibrations which occur either during the process of dissociation or when the ions recombine.—*Phys. Rev.*, November.

Insulators in a Magnetic Field.—S. J. Barnett.—A long illustrated account of an investigation of the electric intensities and electric displacement produced in insulators by their motion in a magnetic field.—*Phys. Rev.*, November.

Electrochemistry and Batteries.

Annealing and Tempering Furnace.—J. E. Kearns.—An illustrated description of an electric annealing and tempering furnace in which the article to be treated is placed in a bath of fused salt. Current is introduced into the bath through two opposite electrodes. According to the temperature desired, the composition of the salt may be varied. The operation of such an electric furnace is cheaper than that of a gas furnace.—*Gen. Elec. Rev.*, December.

Telegraphy, Telephony and Signals.

Telautography.—A. Korn.—An illustrated paper describing the early telautographs of Bakewell and Gray and improvements which have been made in these systems in recent years. These apparatus are used for the transmitting of handwriting, meteorological maps, for the telegraphic transmission of drawings and photographs.—*Phys. Zeit.*, Nov. 1.

Wireless Telegraphy.—W. H. Eccles.—A continuation of his illustrated article in which the author sums up various recent British patents relating to wireless telegraphy and telephony. —Lond. *Electrician*, Nov. 13.

Gas Thermometer.—A. L. Day and J. K. Clement.—An account of an extended research on the gas thermometer. The authors succeeded in perfecting the constant-volume gas thermometer until the aggregate error affecting the measurements between 300 deg. C. and 1150 deg. C. appears not to be greater than 0.5 deg., but they are not yet able to offer adequate assurance that their scale can be reproduced by others with this accuracy. The following melting points in degrees Centigrade are given: Zinc, 418.5 ± 0.1; silver, 958.3 ± 0.5; gold, 1059.3 ± 1.0; copper, 1081.0 ± 0.5.—*Am. Jour. of Science*, November.

Thermo-Wattmeter.—R. van Cauwenberghe.—An article in which the author points out the advantages of the combination of two thermo-elements with a differential galvanometer, this combination constituting a wattmeter. This "thermo-wattmeter" is not subject to the same sources of error as the electrodynamometer. Its disadvantage is that the thermo-elements may change with the time.—*La Lumière Elec.*, Oct. 31.

Units, Measurements and Instruments.

Meter and Relay Connections.—H. W. Brown.—The continuation of his long illustrated serial. In the present instalment he deals with two-phase four-wire circuits, two-phase three-wire circuits, two-phase five-wire circuits, and four-phase four-wire circuits.—*Elec. Jour.*, November.

Resistance.—C. H. Lees.—A mathematical note on the resistance of a conductor of uniform thickness whose breadth suddenly changes, and on the shapes of the stream lines in the immediate neighborhood.—*Phil. Mag.*, November.

BOOK REVIEW.

How To Understand Electrical Work. By W. H. Onken, Jr., and Joseph B. Baker. New York: Harper & Brothers, 1908. Cloth, 359 pp. Illustrated. Crown 8 vo. Price, $1.75.

For some time past the great publishing house of Harper & Brothers has been engaged in developing a series of practical hand books for boys. One or two of these we have already had occasion to comment upon favorably as being helpful and useful. The "Electricity Book for Boys" has now been supplemented by this admirable volume, which might well in turn be developed along the same lines by a book devoted to each of the leading branches of industry of which it treats. The problem before the authors, both thoroughly competent and well informed men, has been to deal adequately with the various fields of discovery and application; and they have discharged themselves very conscientiously of the duty. All electricity is one, and the underlying facts and principles are one—and thereat divergence begins immediately. In reading some popular books about electricity we feel that they resemble the European books seen occasionally, about this hemisphere, wherein "American" embraces comprehensively and without distinction the Patagonian, the Philadelphian and the Prince Edward Islander. Here is a book that makes the sharp and proper divisions as to methods and apparatus, and tells with precision just what is involved in lighting as distinguished from traction, in telegraphy as different from telephony.

As a matter of fact, this book goes about as far as any book dares go, or ought to go, in giving the practical details of each art. It is certainly difficult to draw the line, and in some instances it may be thought that the book is too technical. Our own opinion is that it will find a large circulation on account of the boldness with which it gives engineering data and diagrams. Either the young student wants to know or he does not; if he is worth his salt, he wants to know very keenly, and in these pages he can get the information that will give him an intelligent grasp on the intimate essentials of the "art," whether it be the supply of light, of power, of transportation or of heat.

This book may be warmly commended also for the profusion, variety and clearness of its illustrations. There are plenty of half-tones and a diagram of circuits is given wherever possible. There is also an excellent dictionary of electrical terms.

NEW APPARATUS AND APPLIANCES

Mechanical, Magnetic and Electrical Features of Lifting Magnets.

Unquestionably a successful lifting magnet must withstand in service more severe abuse and rough handling than any other type of electrical apparatus. In operation it is suspended from the hook of a crane (frequently not equipped with a lowering brake) and may be dropped upon the material to be lifted at a speed which may be comparable almost to dropping the magnet from a second-story window. In service it will be swung against cars, charging boxes, piles of pig iron, etc., and must be capable of withstanding the blows and shocks which result. It must operate under all weather conditions, day or night, irrespective of rain or snow, and its insulation must withstand a voltage much higher than line voltage due to the inductive

kick which occurs when the circuit of the magnet is opened. Its winding must not be injured by the large amount of heat which is necessarily generated within it, but preferably also should not be damaged by external heat when the magnet is called upon to handle hot material.

A typical cross-section of a lifting magnet is given in Fig. 1, which shows the arrangement of parts which by experience has been found to meet the severe and exacting requirements of service. In this illustration *A* is the body or framework of the magnet, which is an annular casting of special electrical

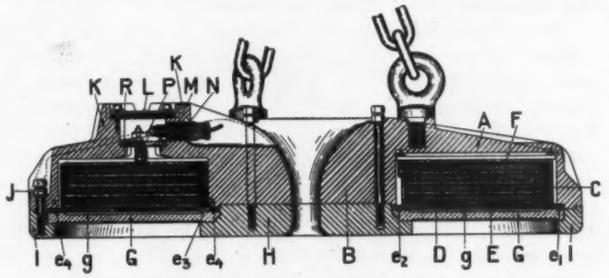


FIG. 1.—SECTIONAL VIEW OF LIFTING MAGNET.

steel heavily ribbed on both its upper and outer surfaces. The ribs serve to add largely to the surface available for dissipating heat and are so disposed as to stiffen the magnet case mechanically and at the same time to add to the cross-section of the magnetic circuit. *B* is the core of the magnet, which is surrounded by the winding *C*. This winding is composed of a series of coils each wound with a conductor in the form of a copper ribbon or strap, the turns of which are insulated with asbestos ribbon. Neighboring coils are mechanically separated and electrically insulated by non-combustible insulating disks *D*. The coils are wound upon a heavy brass form *E* which resembles a spool with one head removed. This form serves to support the coils during the process of winding and insures coils of uniform and perfect shape, since there is no danger of springing or otherwise distorting the winding. After the last or uppermost coil is wound and the outer disk of insulation is in place, the entire winding is rigidly clamped to the form by means of radial straps *F*, which are bolted and locked in place, thus making the winding and the brass form which carries it a rigid unit. The completed winding is then dried in a steam-heated chamber under a vacuum, and when the initial drying process is completed the winding is impregnated with a plastic insulating compound, first under the influence of a vacuum and then under air pressure, and, finally, is again dried under a vacuum. This process results in a winding not only fireproof—not a particle of combustible material being used in its make-up—but what is of still greater importance, the winding is thoroughly waterproofed. The completed winding is then placed in the magnet case.

It will be noted that the form *E* is provided with an outer flange *e1*, and an inner flange *e2*, in addition to the central upwardly-extending flange *e3*, which centrally supports the winding. The inner and outer flanges are carefully finished and engage with finished surfaces on the inner and outer pole faces of the magnet case, thus completely sealing the lower face of the winding chamber, a water-tight joint being insured by clamping the flanges in place with screws, *e4*, *e4*, spaced 4 in. apart entirely around the flanges *e1* and *e2*. Since the winding is clamped to the form *E* by the radial clamps *F*, and the form *E* is clamped to the magnet case by screws placed 4 in. apart entirely around its inner and outer edges, it will be readily seen that the winding is rigidly held against displacement—a result which cannot be reliably obtained by means of wedges or similar expedients.

With the winding thus assembled in the magnet case the lower face of the coil form *E* is covered by a heavy annular plate of non-magnetic manganese steel *G*, which, in turn, is held in place by pole shoes, *H* and *I*, bolted respectively to the inner and outer poles of the magnet case. Both of the pole shoes are provided with shoulders which protect the clamping bolts from shearing strains. The heads of the outer clamping bolts *J* are located between the adjacent ribs on the outer surface of the magnet case, where they are protected from abrasion.

The wearing qualities of manganese steel are well known, this material being used for frog and switch points on modernly equipped railways, both electric and steam. The quality of manganese steel used in the lifting magnets is both hard and tough and at the same time practically non-magnetic.

It will be noted that the manganese-steel plate *G* carries raised shoulders around its inner and outer peripheries by means of which the plate is made to seat against the magnet pole and an air space or cushion is left under the winding, at *g*. This arrangement results in the shocks taken by the outer plate *G*, being transmitted directly to the magnet frame instead of being taken by the winding as would necessarily be the case if only a single bottom plate were used.

The pole shoes are so disposed with respect to the outer plate *G* that none of the clamping surfaces can become battered over, and, therefore, the plate *G* may always be readily renewed.

It will be seen that the entire lower or wearing face of the magnet is renewable and that these renewals can be readily effected, there being no necessity of in any way exposing or disturbing the winding or breaking the water-tight joint between the coil form *E* and the frame of the magnet.

The arrangement of terminals also deserves attention since, no matter how good the design in other respects, if the terminal construction is weak, trouble is certain to result from this cause. The terminal cavity is surrounded by raised walls, *K*, *K*, cast integral with the magnet case and of such thickness as to be as strong as the magnet case itself. The terminal cavity is closed at the top with a heavy steel cover *L*, which seats against a gasket to form a water-tight joint and is firmly bolted in place, the heads of the bolts being protected from abrasion by the walls of the terminal cavity. All of the terminal parts are thus enclosed in a water-proof box of steel. The terminals themselves are of the plug type, which permits of quick attachment and detachment of the service wires. The female members *N* of the terminal are enclosed in an insulating tube so that a "ground" or short-circuit cannot result even

FIG. 2.—LIFTING MAGNET IN OPERATION.

if the service wires are left hanging from the crane when subjected to e.m.f. Each insulating tube is encased in a steel tube to prevent abrasion of the insulation, the steel tubes fitting closely in babbitted openings *N* in the side of the terminal chamber. The male members *P* of the plug connectors are mounted upon a heavy plate *R* of fireproof insulating material which closes the entrance to the winding chamber and is seated upon a gasket to effect a water-tight joint. The plugs proper are separable from the terminals by removing the nuts which hold them in place. The plugs and also the plate *R* may, there-

fore, be removed without throwing any strain on the connections to the winding, the connections consisting of loops of very flexible copper ribbon, these loops being stowed away in the box-like ends of the terminal studs. This construction permits of great flexibility and at the same time makes it impossible for the flexible leads which connect to the two ends of the magnet winding to come into accidental contact.

It is claimed that a magnet of the above-described type, 40 in. in diameter, is capable of lifting substantially as much as older forms of magnets 50 in. in diameter with substantially the same power consumption, but weigh 2000 lb. less.

The above-described type of magnet has been developed by the Electric Controller & Manufacturing Company, Cleveland, Ohio.

Side-Crank Steam Engine.

The Ridgway Dynamo & Engine Company, of Ridgway, Pa., has brought out a line of side-crank steam engines to supplement its well-known line of center-crank machines. The engines are built in the simple, tandem-compound and cross-compound types, the last in sizes up to 1500 hp and the two first in sizes ranging from 50 hp to 800 hp. In the cross-compound engines the low-pressure valve is of the balanced type and the high-pressure valve is driven by the governor, the low-pressure valve being driven by a fixed eccentric on the main shaft. In the tandem-compound engines both valves are driven by the governor, the low-pressure directly and the high-pressure by means of a tail rod on the low-pressure valve. Figs. 1 and 2 show the features of the engines and a view of the fly-wheel governor used is shown in Fig. 3. Inspection of the engravings show that consideration was bestowed on small details as well as pleasing outlines.

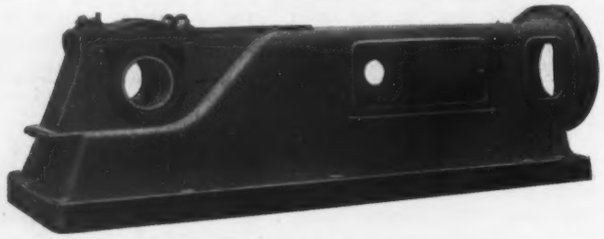


FIG. 1.—ENGINE BED CASTING.

As shown in Fig. 1, the bed is of heavy design throughout. The main part of the bed is of a box section and the guides and end for the cylinder are bored and turned at one setting on a special machine to insure alignment. At the cylinder end of the bed is a removable partition provided with sectional packing around the piston rod to prevent oil from being thrown against the end of the cylinder. Between the cylinder and the partition is a well in which the drip from the stuffing box is caught. The water is removed by a separator and the oil flows back to the crank pit. Ample openings are provided for packing the piston rod stuffing box, and other openings closed by light cast-iron doors give easy access to the cross head and pin. The crank disk is covered with an oil-tight guard hinged at the top so that it may be turned back over the bed, giving access to the connecting rod and crank pin. A small opening in the side of the guard has a swinging cover and furnishes means for inspecting the crank pin while the engine is in motion.

The main bearing is of the quarter box type. The shells are lined with babbit carefully pened in place and bored out in accurate jigs. They are therefore interchangeable in engines of the same size. Horizontal adjustment is secured by a wedge and vertical adjustment by drawing down the cap. Both the top and bottom shells are interchangeable and may be removed without taking the shaft from the bed.

The connecting rod is forged from open hearth steel and the straps at both ends are slotted out of the solid forging. The wrist pin box is of phosphor bronze, while the crank pin box is lined with babbitt. Both ends are adjusted by the wedge-and-bolt method. The cross head body is of cast steel, with shoes of cast iron faced with babbitt. The upper shoe is bolted to the body, while the lower shoe is adjustable. Four hollow bolts pass through the cross head body and inside of these bolts are placed the cap bolts which hold the shoe firmly. Means have been provided, however, for adjusting both top and bottom shoes by the use of shims, should this arrangement be desired. The wrist pin is made of carbon steel tapered to fit seats in each side of the cross head body and provided with keys so that it may be turned 90 deg. as it wears.

The cylinder and valve are the same as those used in the company's center crank engines. The cylinder is cast of a hard, close-grained iron, the walls being made thick enough for several reborings. The barrel of the cylinder is covered by a heavy polished cast-iron lagging, and over the cylinder head and nuts is placed a false head having a polished rim and center. The valve is of the flat balanced type. It moves between the seat and a heavy pressure plate, which relieves it of all pressure, holding it against the seat. In the pressure plate are cored ports, corresponding to those in the valve seat and connecting through side openings with the main ports, thus making a double-ported valve. This construction gives an indicator card in which the steam line holds up well and cut-off is very sharp. The pressure plate is held in place by lugs on the edges and a spring on the back. In case of water being carried into the cylinder, both valve and pressure plate lift from the seat and allow the water to pass into the exhaust. Relief valves are, therefore, not necessary.

The piston is a single hollow casting, strongly braced by ribs. It is packed with cast-iron snap rings of a special design. The piston rod is large in diameter and is made of machinery steel. The rod and piston are joined by a force taper fit, supplemented by a jamb nut. The rod screws into the cross head with a long, fine thread and is prevented from turning by a jamb nut. This jamb nut is further held by a set screw in the cross head body.

The main shaft is a forging of open hearth steel. It is large in the bearings and proportionately increased in the governor wheel hub. The crank disk is made of a mixture of cast iron and steel. Because of the size of the crank pin and the shaft at the crank fit, the crank pin is cast solid with the disk. The shape of the disk is such that satisfactory counterbalance is obtained. After the pin is turned and the shaft fit bored, the crank is forged to place on the shaft under hydraulic pressure and secured by a heavy key.

The most important part of a high-grade engine is the governor, and perfect regulation is very essential, especially in engines for driving electrical machinery. In the Ridgway governor a long bar, called the inertia bar, having weights at each end, is pivoted at the center on a roller bearing. The main pin is made large and heavy and is of steel, hardened and ground. The inertia bar is lined with hardened steel bushings and the space between pin and bushings is filled with hardened steel rollers, so as to insure a minimum of friction. This is the only bearing requiring lubrication, although it will go without attention for several weeks. To the hub of this bearing is clamped the eccentric which is keyed in place and is also held by set screws. The eccentric and eccentric strap being split,

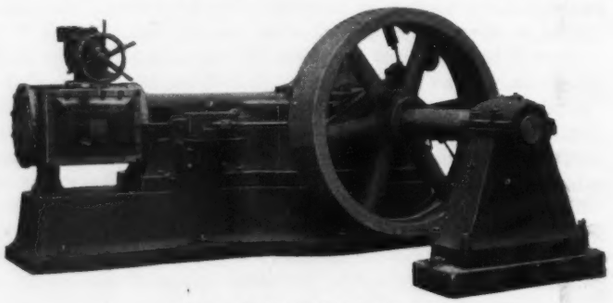


FIG. 2.—SIDE CRANK ENGINE.

are removable without disturbing the governor or the setting of the valve. A heavy coil spring is secured to the middle of one end of the bar. Opposite the spring is an oil dash pot, consisting of a cylinder with a loose fitting piston and a connecting rod bolted to the inertia bar. A by-pass with an adjustable opening allows the oil to circulate from one side of the piston to the other. The governor is reversible without the use of any extra parts. Referring to Fig. 3, the action of the governor is as follows, rotation being from right to left: The weight in the spring end of the bar being the greater, centrif-

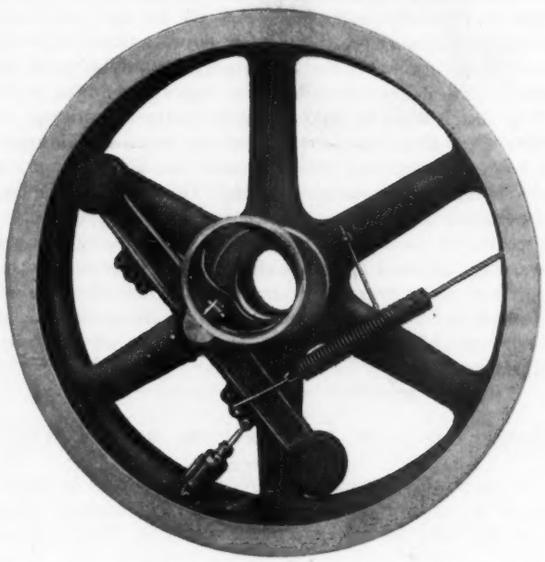


FIG. 3.—FLY-WHEEL GOVERNOR.

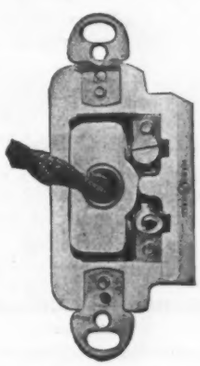
ugal force tends to swing it outward and backward toward the lower stop. This tendency to move backward is balanced by the spring, whose tension is such as to hold the inertia bar in equilibrium when the engine is at its desired speed. When starting up, the position of the governor parts are as shown. In this position the ecentric travels in its greatest path, giving the valve its widest opening and latest cut-off. As the speed increases, centrifugal force, acting on the weighted end of the inertia bar, moves it backward toward the lower stop, thereby reducing the travel of the valve and cutting off steam earlier. This backward movement of the bar is continued until the travel of the valve reduces cut-off to just the amount necessary to keep the engine rotating at its proper speed to give even balance between centrifugal force acting on the inertia bar and the opposing tension of the spring. When a load is applied to the engine, there is a check to the speed of the governor wheel, while the inertia bar, by reason of its momentum, rotates forward sufficiently to increase valve travel and give late enough cut-off to carry the load. Should the load be thrown off, the governor wheel tends to increase its speed, thus causing the inertia bar to swing backward and reduce valve travel and cut-off until equilibrium is established as before. From this it will be seen that the speed of rotation, under a steady load, depends entirely upon the equilibrium between centrifugal force acting on the inertia bar, and the tension of the governor spring, while the actual movement of the governor parts is effected by the inertia of the weighted end of the bar. If the weight in the inertia bar and the tension of the spring are so adjusted that the centrifugal force increases faster than the tension of the spring, then the engine will speed up under load. In this condition the engine is liable to race and it is to prevent racing that the dash-pot is used. It is thus possible to adjust the engine so that it will run faster under load than when running light, and still have it regulate perfectly with no tendency to race. Contrariwise, the governor may be adjusted to run slower under load than with no load. Dash-pots are used on all engines, as by their use perfect stability is obtained and at the same time they increase the ease with which adjustments may be made. No difficulty is said to be experienced in adjusting this engine to govern within a limit of one revolution, and the instantaneous variation of speed when the entire load is thrown on or off is claimed to be less than 2 per cent, while the action of the governor is unusually quick, the engine returning to its normal speed with a single vibration and within a space of two seconds.

The design of the valve gear is readily seen in the cuts. It is made simple and strong. The ram slide has a long bearing and is provided with horizontal and vertical adjustments. All pins and rods are of steel, the eccentric strap is lined with babbitt, pened, bored and scraped, while the bearing at the slide is lined with a replaceable bronze bushing having a screw adjustment. In harmony with the proportions of the bed and sub-base, the outboard bearing pedestal is built on liberal lines and made broad at the base to insure stiffness. The bearing is of the self-oiling, self-aligning type, the shells being lined with babbitt, pened and bored.

Two methods of lubricating the engine are provided. In the "splash system" the crank pit is filled with oil, which the disk throws in an almost steady stream over the cross head and guides. Oil from the upper guide is wiped off by the top cross-head shoe and flows through passages and pipes to the cross-head pin. Pockets on the inside of the crank guard collect great quantities of oil, which are led through ample passages to the main bearings and to the crank pin. All bearings are, therefore, practically flooded at all times. This system is furnished, unless otherwise specified. The second system uses a small filter placed in one side of a tank, which is mounted on the sub-base below the slide bracket. In the other side of the tank is a valveless pump driven by a cam on the valve gear ram. This cam is designed to give a full stroke regardless of the travel of the ram. All oil from the bearings flows to the crank pit, from which it is piped to the filter, then passes to the pump chamber whence it is pumped to a large tank on top of the bed. Sight feed valves are placed in each pipe near the tank so that the supply may be shut off or regulated. As the engine is fully enclosed, no oil can be thrown onto the floor or into the governor wheel. With either system the valve gear is supplied with grease cups, which are both effective and cleanly.

Polarity Flush Plug and Receptacle.

The increasing diversity in the use of electricity has rendered more important the problem of temporary connections usually spoken of as plugs and receptacles in all classes of buildings.



POLARITY FLUSH PLUG AND RECEPTACLE.

Moreover, it is frequently desirable, especially in direct-current work, that the circuit be always of the same polarity, so that in order to avoid mistakes, such as causing an arc lamp to burn upside down or a motor to run in a reverse direction, the plug and receptacle should be of the polarity type. A shallower and smaller receptacle with sufficient capacity and also flexibility, so as to be adaptable to the ordinary plug fixture but interchangeable with plugs that are used on socket fixtures,

possesses desirable advantages in wiring work. The Marshall Electric Company, of Boston, Mass., has brought out a device embodying the advantages enumerated above in which also the binding screws cannot work loose. This receptacle is shown herewith. As ordinarily fitted up, the receptacle has a porcelain base, 1⅜ in. deep. The binding screws are provided with the company's spring lock, which prevents their working loose and open-circuiting the wires. The plug is provided with an adjustable bushing to accommodate either plain or reinforced cord and the latter is fastened with a grip as required by the underwriters. The plug will only fit in one way, thus assuring a fixed polarity. A special plug may be inserted in this receptacle and an ordinary push-button switch plate put on in place of the regular receptacle plate. The device is then adapted to take the company's separable attachment plug. The Underwriters have approved the device.

Sectional Steel Poles.

The Sciple sectional steel pole here illustrated is built up from sections of round, flat, angle or "T" steel, the best form for general use being considered this type, which is composed of ordinary angle steel, the material used chiefly in the construction of windmill towers. A special feature consists in the joint, which is made up of a cast spool and rings. The top of the angle fits into the lower angular recesses in the joint, the upper rim of the spool resting on the top of the angles. The lower ends of the angles rest on the lower rim of the spool, and the ring fits down over all, holding the members firmly in place. The cap consists of a cone somewhat similar in design, with angular recesses to receive the upper ends of the angles, the cap fitting over and holding the members in place. The base and cap are connected by a tie rod which extends through the entire pole and is fitted with a turnbuckle, by means of which the pole is kept tight and rigid.

SECTIONAL POLE.

The weight and size of the material used depends, of course, upon the nature of the load imposed, but the essential features of design remain the same. A special cross arm is also provided, but if desired any cross arm can be used; ordinary wooden arms being attached by means of clevis bolts, while for trolley use and transmission lines, adjustment is also readily made to the conditions. The metal cap can be used on wooden poles, protecting them from moisture and obviating the necessity of cutting in or boring holes which would cause decay. This pole is made by the Sciple Sectional Steel Pole Company, of Minneapolis, Minn. This concern does not claim to be able to compete in meeting the present price of small-size wooden poles, as far as first cost goes, but bases its argument on the longer life and durability.

Extension Diffusers.

The extension diffuser illustrated herewith has been designed by the General Electric Company for use on railway cars, but is especially adapted and recommended for store lighting and for installation on low ceilings. As will be noted, the construction of the outfit is remarkably simple; the appearance neat and pleasing. The diffuser can be installed on any ceiling where a small, flat space is available, or it can be suspended from open work construction. It is readily adapted for recessing so that the outer edge is flush with the ceiling line.

The diffuser is held in place by the suspension rods from which the shade is hung, and the heavy dull finish makes it difficult to distinguish it from plaster. The shade is of white opalescent art glass, strongly bound together, and is specially constructed for rigidity. The glass used in the shade is selected and arranged so as to give maximum diffusion with the minimum absorption of light.

At the present time, the extension diffuser is made in two sizes only, the three- and six-light; both, however, being adapted for use with tungsten, tantalum, or "Gem" lamps. The lower shades are made in two different styles, known as the deep and the shallow types, and are used with lamps of sizes up to and including 40-watt tungsten, 40-watt tantalum, and 40-watt "Gem." The deep shades are necessary for use with lamps up to and including 100-watt tungsten, 80-watt tantalum, and 125-watt "Gem." Clear glass lamps only should be used, as the light is thoroughly diffused by the upper and lower shades.

The distribution of light from the extension diffuser is not symmetrical about the vertical axis as in most lighting units. At angles approaching the horizontal the diffuser emits more light laterally than longitudinally. This is of advantage in stores when the equipments are installed longitudinally over the center of the aisle. The maximum light being thrown out toward the counters and stock shelves, very little light is thrown directly into the eyes of the customers. The efficiency of the extension diffuser, when compared with other lighting units, is relatively high, especially in consideration of the excellent diffusion.

Metal Lockers for Stations and Factories.

One of the interesting developments of the time in the direction of better fire protection and improved sanitary arrangements has been the resort to metal furniture. Wood has given way to steel in this respect as in so many others; and there seems to be little but gain and advantage. Metal lockers are part of this advance in interior fittings, and in electrical plants and factories are finding general adoption, being germproof, fireproof, time savers, and otherwise elements making for efficiency and economy. Herewith are illustrated two of the appliances of this nature made by Edward Darby & Sons Company, of Arch Street, Philadelphia, who have introduced a wide range of such articles. Fig. 1 shows an open set of shelving and racks for tools, material or merchandise; while Fig. 2

EXTENSION DIFFUSER.

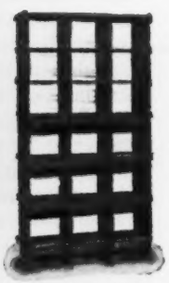


FIG. 1.—SHELVING AND RACKS.

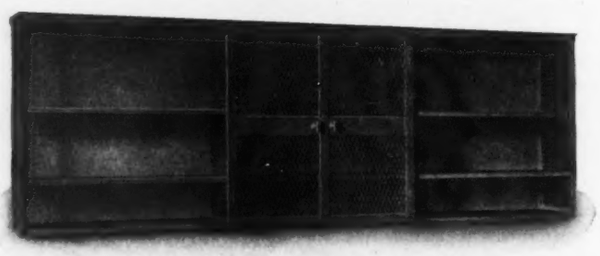


FIG. 2.—COMBINATION LOCKER.

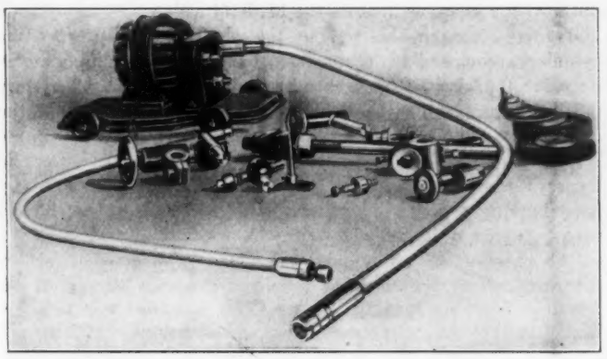
shows a combination form with enclosed space under lock and key, where special jigs, dies or other valuable parts or tools can be kept. Outside of these types there is, however, a very large assortment made of wire and sheet frame lockers for every kind of use.

Bureau of Illuminating Engineering.

The Bureau of Electrical Engineering, a corporation, 437 Fifth Avenue, New York, has for one of its objects the carrying out for central stations not provided with organized illuminating engineering or commercial departments the work usually assigned to such departments, and also to act as consulting engineers for companies which maintain these departments, where special expert advice is desirable. Contracts are made in this connection which permit companies to submit a stipulated number of lighting problems during a stated period of time. The Bureau also acts in the capacity of consulting and designing illuminating engineers for architects, governments, gas companies, engineers, municipalities, public service commissions, owners of buildings, etc. Among its work is the design of globes and reflectors of all types, lighting fixtures, signs, spectacular, outline, display and decorative lighting effects, and the specifications of lighting systems for streets, parks, expositions and fairs. Mr. Albert J. Marshall is chief engineer of the Bureau.

Small Motor-Driven Emery Wheels, Buffers and Drills.

The illustration herewith shows a handy motor-driven flexible shaft outfit furnished to the United States government by the Coates Clipper Manufacturing Company, of Worcester, Mass. The equipment consists of a breast drill, drill press, emery wheels and polishers, and is provided with a multiplier, clamp, spindle, old-man, etc. The motor is a 1-hp Westinghouse alternating-current motor mounted on a portable truck and fitted with speed-changing head and flexible shaft.



MOTOR-DRIVEN EMERY WHEELS, BUFFERS AND DRILLS.

In order to obtain the proper cutting speeds for emery wheels of different diameters, multipliers of the proper ratios are used. The two which can be used to best advantage are those having ratios of 8½ to 1 and 6½ to 1, respectively, the former for use with ⅜-in., ½-in. and 1-in. wheels and the latter for 2-in. and 3-in. wheels. Larger sizes are used on a clamp spindle which runs at the speed of the shaft, 1800 to 2500 r.p.m. By removing the breast plate on the drill and attaching a combination old-man, drilling up to ½ in. can be readily done. Larger drills up to 1¼ in. are used in connection with a worm-feed drill press and old-man attachment.

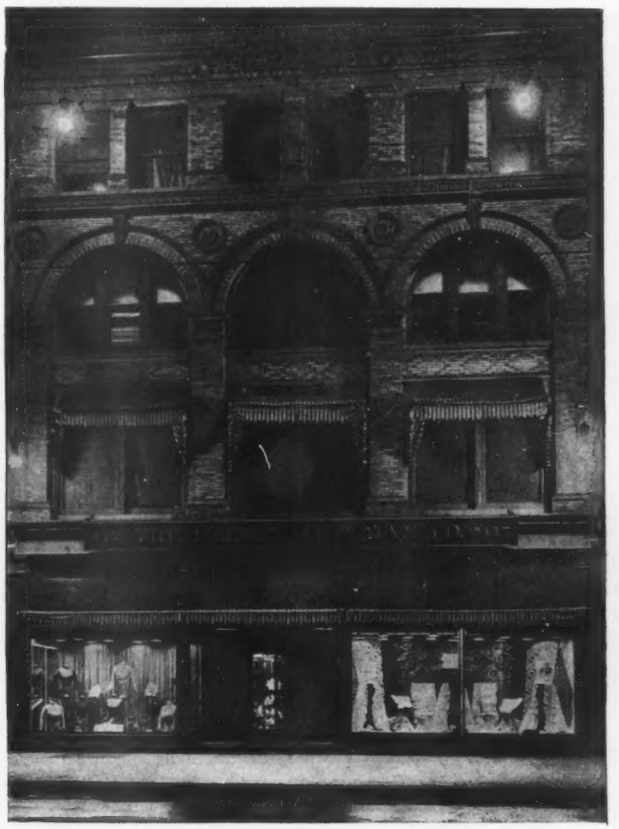
The outfit is so arranged that a heavy or light shaft can be used according to the requirements of the work. The smaller shaft is fitted with a taper end sleeve for taking small tools, and the larger shaft with clutch sleeve and grab-dog clutches so that one tool can be used after another without making any change in the shaft.

Advertising with Flame Arc Lamps.

The first flame-arc lamps used in this country were of foreign manufacture. It was, however, only a comparatively short time after their introduction that American manufacturers awoke to the realization that the lamp was destined to play an important part in decorative lighting. The result was that at the present time there are several American-made lamps on the market, all of which are widely advertised.

Although in foreign countries the flame-arc lamp has been widely adopted for street illumination, its use in this country is confined principally to the illumination of store fronts and amusement places, such as theaters, parks, etc. While its use in connection with mercantile establishments is principally to attract attention, it can at the same time be used to advantage for the illumination of the store windows, thus serving a double purpose. For this service the lamps are suspended from suitable supports just above the top of the window.

To the brilliant light emitted by the flame-arc lamp when in operation is due its advertising or attention-attracting quality. The entire globe seems filled with a luminous gas and, although the light has the property of penetrating the thickest fogs or smoke, it is soft and not blinding to the eye like that of the enclosed arc. Electrodes giving a yellow or orange colored light are generally used, but electrodes may be obtained that will give a light of a red or white color.



STORE FRONT LIGHTED WITH FLAME ARC LAMPS.

The accompanying illustration shows the front of a department store in Schenectady, N. Y., lighted with four flame-arc lamps of a type manufactured by the General Electric Company. This illumination was reproduced from a photograph taken at night solely by the light of the lamps, and although it fails to show the true beauty of the illumination, it gives an idea of the appearance of the store at night. This is only one of many similar installations in this city, and it is interesting to note that the merchants have clubbed together and made arrangements to have the entire business section lighted with G-I flame-arc lamps. The lamps will be placed at equal intervals along both sides of the street and at the same height from the sidewalk.

Adjustable Socket Clusters.

The Benjamin Electric Manufacturing Company, of Chicago, is bringing out the types of adjustable socket clusters shown in Figs. 1 and 2. These clusters are intended for use in art-glass domes and similar places where it is desirable to adjust the lamps close to the sides of the dome or reflector. By means of these clusters each socket may be turned to any position between two points 180 deg. apart and locked there by means of a screw. The binding screws are easily accessible by

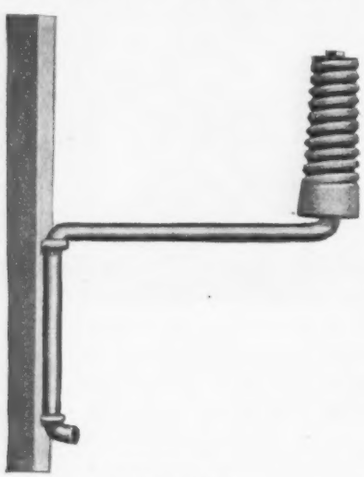
FIG. 1.—ADJUSTABLE SOCKET CLUSTER.

FIG. 2.—ADJUSTABLE SOCKET CLUSTER.

removing the socket cap. Fig. 1 shows this cluster as adapted to attachment to a nipple. Fig. 2 shows it with the Benjamin attachment plug feature after attachment to an existing socket.

Rotary Tree Bracket.

The device illustrated herewith is the Buckbee rotary tree bracket, which is made solely by the W. H. Olmstead Manufacturing Company, of Townsend Avenue, Detroit, Mich. It can be placed at any angle in one minute by driving two staples. It will fit any standard insulator, and holds the line away from the tree or object to which the bracket is attached at a clear distance of 9 in., while it allows the supporting object to move 18 in. with no strain on the wire or bracket. At the same time it is impossible for the wire to come in contact with the tree

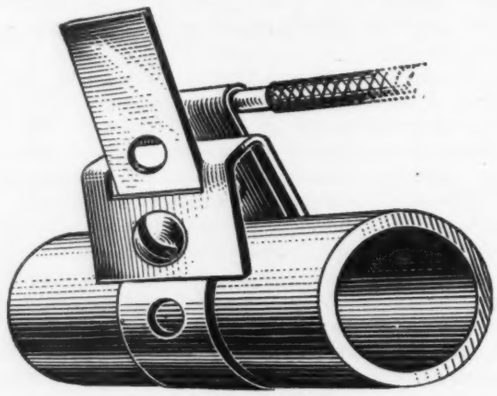


ROTARY TREE-BRACKET.

and impair the service, and hence also there is no wearing off as regards the insulation. It is made of ⅜-in. Bessemer steel rod.

Ground Clamp.

The clamp illustrated herewith was designed by the Fairmount Electric & Manufacturing Company, Philadelphia, with the object of reducing the number of sizes of this device for ordinary work. There are only three sizes, namely, A, which takes from ½- to 1-in. pipe; B, which takes from ½- to 2-in. pipe, and C, which takes from ½- to 3-in. pipe. In going out on a job the wireman will thus not be required to carry with him the large assortment of sizes required when the individual size clamp is used. The clamp is composed of a soft copper band with a turned-up end fitting a lug to which the ground wire is easily soldered. The clamp device is made of steel,

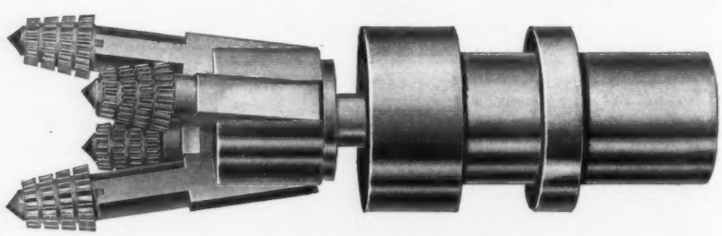


GROUND CLAMP.

copper-plated, and the bolt is also copper-plated. It is very easily attached, and when placed on a pipe has a grip so firm that it cannot be moved or twisted with a wrench. It is obvious that this clamp can be manufactured and sold more cheaply than in the case of an assortment of eight different sizes.

Boiler Tube Cleaner.

The tube cleaner manufactured by the Liberty Manufacturing Company, of Pittsburg, Pa., and shown herewith, is preferably operated by compressed air, although satisfactory results are said to be obtained with steam. The cylinder contains an eccentrically mounted shaft having a longitudinal slot carrying a pair of balanced blades. Air is supplied through longitudinal ports in the cylinder, and as the blades revolve they move back and forth through the slot in the shaft. The ends of the cylinder are closed by removable steel heads containing bearings for the shaft. These heads are held in place by screws passing through them and through longitudinal holes in the cylinder walls and seating in the rear head. By removing these screws the machine can be taken apart for examination. The faces of the heads adjacent to the cylinder are protected by hard bearing surfaces in contact with the ends of the blades so as to prevent end-blade wear. A special lubricator placed in the path of the air supply and usually connected direct to the rear end of the machine admits a constant supply of oil



BOILER-TUBE CLEANER.

to the cylinder, which is forced into the bearings under pressure. An air chamber surrounding the rear bearing is vented to the atmosphere, so that the oil is distributed to both the front and rear bearings without the use of any exterior oil ports. When operated with compressed air a small amount of water is supplied through an ordinary garden hose to moisten the scale, and when steam is used the same arrangement is employed to reduce the temperature of the tube. The device is said to operate to best advantage under an air pressure of 50 lb., the amount of air ranging from 25 cu. ft. to 50 cu. ft. of free air per minute, depending upon the thickness of the scale. When steam is used a pressure of from 35 lb. to 50 lb. is necessary. The device is adapted to all standard boilers.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

While the general tendency of business in commercial lines is still toward improvement, the past week recorded something like a pause in activity. There are several reasons for this condition. The most important of these is the fact that in the South and West unseasonably warm weather has interfered with retail merchants, and that along the Atlantic coast heavy fogs have seriously retarded shipping movements. In the South, also, business is being held back by the continued low price of cotton. The planters are disposed to hold their crops until prices reach remunerative figures, and this, of course, restricts the amount of ready cash in the hands of consumers. In the Northwest conditions are still good owing to the high prices that are being obtained for cereals and other farm products. Taken as a whole, therefore, conditions over the country are irregular. There is in every locality the same feeling of optimism which has existed since the election. This is especially to be observed in manufacturing centers, where considerable purchases of raw materials are being made preparatory to busy times that are expected after the new year begins. Reports of the railroads are more favorable than at any time during the year. As a rule losses from a similar period in 1907 are not more than 10 per cent. The number of idle cars is gradually diminishing, and railroad managers expect that there will be shortages before the end of January. Business failures for the week ended Nov. 26, as reported by *Bradstreet's*, were 193, as against 273 for the previous week, 258 for the same week last year, 174 in 1906, 188 in 1905 and 184 in 1904.

THE COPPER MARKET.

The copper market seems to be in a better condition than at the end of the previous week. Not only has there been some advance in quotations, but the demand both at home and abroad seems to have improved. Up to the Thanksgiving holidays there was continued pressure to sell, and buyers seemed reluctant to come into the field. Immediately after the holiday there was a sharp rally, prices stiffened and buyers seemed to be awake. This rally was probably due to the fact that many of the weak holders had been shaken out on the decline and that holders who were financially strong accumulated stocks at the bottom figure. In London the market was particularly active, the speculative element selling standard warrants liberally and buying electrolytic copper in this market to cover the sales. These purchases gave the local market some life and caused prices to be marked up. The sales, however, were not large, either in this country or Europe, and it is especially noticeable that consumers seem to be largely out of the market. They are not even seeking to purchase for future delivery, and this is taken to mean that they are influenced by the statistical position to believe that high prices cannot be maintained. It is figured that domestic consumption was only about 45,000,000 lb; exports for the month were 17,940 tons, or in the neighborhood of 40,000,000 lb., leaving an apparent surplus of 25,000,000 lb. The selling agencies and mine owners declare that there is no surplus, and that recent takings have depleted stocks, but the figures do not bear out this assertion.

Prices on the Metal Exchange Nov. 30 were:

Lake	14⅜	@	14½
Electrolytic	14⅛	@	14¼
Castings	14	@	14⅛

London prices were as follows:

	Noon. £	s	d	Close. £	s	d
Standard copper, spot	63	17	6	63	15	0
Standard copper, futures	64	17	6	64	13	9
Market	Firm.			Easy.		
Sales of spot				100 tons		
Sales of futures				1,000 tons		

Extreme fluctuations for this year:

	Highest. £	s	d	Lowest. £	s	d
Lake copper, spot	14½			12⅜		
Electrolytic copper, spot	14⅜			12¼		
Casting copper, spot	14¼			12⅛		
London, spot	£64	17	6	£56	5	0
London, futures	65	15	0	56	17	0
London, best selected	68	10	0	60	0	0

RENO POWER TRANSFERS.—The recent sale of power companies at and near Reno, Nev., includes not only the stock of the Truckee River General Electric Company, but the controlling interest in the Union Light & Water Company, the Hunter Creek Water Company, the Washoe Power & Development Company, the Reno Power, Light & Water Company, the Carson Coal & Gas Company and the Reno Traction Company. The Truckee River General Electric Company owns two large power plants on the Truckee River, one at Fleisch and one at Ferad, the third power house is owned by the Reno Power, Light & Water Company, but the stock of all the companies named is controlled by the Truckee River General Electric Company. The Reno Traction Company owns street car lines in and between Reno and Sparks. The Traction company, which has not done any building for more than a year, has commenced extending its Fourth Street line, and Manager Campbell states that this line will be extended to the western end of Fourth Street immediately, and will probably be extended into the northwestern district of the city later on. The Truckee River General Electric Company furnishes power for the mines in Virginia City and Yerington, to the Carson Coal & Gas Company, of Carson City; the Reno Power, Light & Water Company and the Reno Traction Company. The Union Light & Water Company is a combination of the Hunter Creek Water Company and the Washoe Power & Development Company, which were built to compete with the Fleischhacker interests in Reno, but which were absorbed.

WESTERN ELECTRIC EQUIPMENT OF NEW YORK OFFICE BUILDING.—The Western Electric Company has recently completed the electrical equipment of the Marbridge Building, Thirty-fourth Street and Broadway, New York City, which embraces one of the most diverse installations that has been erected, Messrs. C. O. Mailloux and C. E. Knox, consulting engineers, having omitted nothing that could contribute to the perfection of the plant. The generating equipment consists of one 100-kw and two 300-kw, 120-volt, compound, direct-current generators, direct connected to triple, non-condensing Rice & Sargent engines. The switchboard in the engine room is in three sections of 11 panels, and is approximately 31 ft. long. From this board 51 feeders carry both power and light current to distribution centers located on the different floors. There is a total of 2752 outlets for lighting and switches. A secondary or low-voltage equipment comprises a watchman's time detector, fire alarm, electrical sprinkler, call bell, annunciator and general intercommunicating system.

REPORTS OF GROWING BUSINESS.—There is no doubt about the rapid increase of business in the electrical industries within the past few months. The Allis-Chalmers Company reports an increase of more than 60 per cent in October over the business done in September. Further improvement is noted in November. The Western Electric reports that its gross sales are running at about the rate of $30,000,000 per year. There is a steady increase in the orders received. The Otis Elevator Company reports an increase of 25 per cent in business over three months ago, with orders gaining all the time.

THE SIEMENS-HALSKE COMPANY and Simens-Schuckert Works, of Germany, having recently established sales offices in this country at 50 Church Street, New York City, will in a few weeks bring their new types of flaming arc and "Alba" lamps on the American market.

UNION SWITCH & SIGNAL COMPANY.—The contract for the block and interlocking signal devices of the Cortlandt Street tunnels of the Hudson & Manhattan Railroad Company has been awarded to the Union Switch & Signal Company, of Swissvale, Pa.

OREGON ENGINEERING COMPANY.—One of the largest construction engineering companies in Oregon has recently been incorporated as the Oregon Engineering Company, with E. G. Amme as president, M. A. Beardsworth secretary-treasurer-manager, Anthony Nover vice-president and John B. Hardin superintendent. The company has its offices at 329 Beck Building, Portland, Ore., and will do general electric contracting work. Mr. Amme has installed some of the largest plants in the far West, including the electrical equipment of the Lewis-Clark Exposition at Portland. Mr. Beardsworth was for some time with the Seattle Electric Company, and with Mr. Amme put in the electrical work in the Beck Building at Portland. The Oregon Engineering Company represents the Cleveland Crane & Engineering Company, of Wickliffe, Ohio. The company is to do the engineering work for the Central Oregon Power Company, which will install a 10,000-hp plant in the Santiam Valley to develop power for Salem and Albany and surrounding country. The plant at Santiam will consist of four 2500-hp turbines and will take water from the north branch of the Santiam River. The cost of the plant is approximately $400,000.

PHILADELPHIA ELECTRIC BUS COMPANY SUSPENDS.—The Auto Transit Company, which has operated a line of automobile coaches and omnibuses in Philadelphia for more than a year, was placed in the hands of the Commercial Trust Company and George McCurdy, president of the Common Council, as receivers Nov. 18. They withdrew the coaches and omnibuses from service at once. Mr. Peter J. Hughes, vice-president and general manager of the company, said: "The company has gone into the hands of receivers because its expenditures were in excess of its receipts. The public would not pay the price to maintain this electric automobile service, many citizens and business men's associations assuming that the company could operate at a 5-cent fare."

NEW OHIO ELECTRIC INCORPORATIONS.—The annual report of Secretary of State Carmi A. Thompson, of Ohio, shows that within the past year 25 electric light and power companies have been incorporated with an aggregate capital stock of $4,661,000. Seventeen new street and interurban railways were chartered with a capitalization of $1,497,750, and 30 telephone companies.

THE LUTZ-LOCKWOOD MANUFACTURING COMPANY, of 39 Cortlandt Street, New York, has taken over the business of and absorbed the Gordon Battery Company. Although the Lutz-Lockwood Company has controlled the Gordon company since last May, the formal absorption of the business under the former corporate name dates from Nov. 16.

LARGE TUNGSTEN LAMP ORDER.—The F. W. Woolworth Company, operating a chain of 10-cent stores throughout the country, about 250 in number, has recently made a contract to equip all of its establishments with tungsten lamps for interior lighting. The contract involves from 20,000 to 25,000 lamps, which will be of foreign make.

THE KIMBLE ELECTRIC COMPANY, Chicago, Ill., has rented another floor of the building occupied by it at 617 West Adams Street, Chicago, and will enlarge its plant for the manufacture of its alternating-current variable-speed motors. The present plant will be operated night and day in December to take care of the increased business.

Financial Intelligence.

THE WEEK IN WALL STREET.

As a rule, the general changes during the week in the stock market on Wall Street were advances. This is not due entirely to the fact that there was little business done, but is probably due to the fact that in the decline of the week previous stocks had about reached the lowest level at which those who control the stock market are willing to let them go. The volume of transactions during the week under review was greatly reduced, and this indicates that the public is taking a very much smaller part in the Wall Street market than it did during the few weeks immediately succeeding the election. As far as the physical and commercial conditions, which are supposed to govern the stock market, are concerned, they are all favorable, if not to higher prices to at least a maintenance of the present level. There is no doubt that there is an increase in commercial business; there is no doubt that there is an increase in the employment of labor in industries, and there is no doubt that many large propositions are only awaiting a favorable market to finance extensive improvements and extensions. This condition of affairs is pretty well understood by all speculators and also by the holders of securities. The effect of it is that while there may be no immediate advances, it is hardly probable that there will be any serious declines in present quotations. The discussion of the tariff, which is occupying the time of so many experts in Washington, is certainly having an irritating influence upon the steel industry. The fact that Mr. Carnegie, although he still holds as the principal part of his wealth the bonds of the steel corporation, should advocate the elimination of a tariff on steel products is necessarily a disturbing element. While, of course, everyone recognizes that the tariff was intended to foster an industry very much less robust than that of the present steel corporation, it is also a well-known fact that a large percentage of the profits in the manufacture of steel products is due to the protective tariff. That Mr. Carnegie's declaration in favor of free trade had no effect upon the price of the stocks of the steel corporation indicates that it was not generally believed such a declaration would have any effect uponu legislation. The United States Steel Corporation has indicated during the past year—a time of depression—that it can make reasonable dividends even upon its common stock while operating upon a business equal to only 50 per cent of its capacity. Such things as these are bullish arguments in favor of the steel securities. Outside of the stock market there has been apparent, not only for the past week but for many months, a tremendous desire for good bonds. The bond market seems to be an unquenchable fire. Any reputable mortgage security which offers more than 4 per cent can be sold at a premium in this market, and the greediness for this kind of securities has exhibited itself in the fact that many issues have been largely oversubscribed when they were first proposed. This is not only true of industrials and railroads but all kinds of electric securities have been just as eagerly taken. The holiday in the middle of the past week did much to split up trading interests, but at that there were considerable buying and selling, and prices were well maintained until the end. Money has remained cheap, and there seems to be an unlimited supply for all legitimate transactions. On Nov. 30 call loans were quoted at 1@2 per cent, with the majority of loans made at 1¾ per cent; 90-day paper was quoted at 2¾@3 per cent. The quotations in the table are those of the close, Nov. 30:

NEW YORK.

	Nov. 23.	Nov. 30.	Shares sold.		Nov. 23.	Nov. 30.	Shares sold.
All.-Ch.	14	14¾	3,775	Int.-Met., pfd.	34	35	14,500
All.-Ch., pfd.	48	48¾	5,200	Mackay Cos.	76	75½	835
Amal. Cop.	82½	84¾	113,750	Mackay Cos., pfd.	70¾*	71	900
Am. D. T.	35*	35*	——	Manhattan Elev.	142	147	4,770
Am. Loc.	54½	56	5,300	Met. St. Ry.	30⅞*	30	200
Am. Loc., pfd.	109	110*	200	N.Y. & N.J.Tel.	122*	122*	——
Am. Tel. & Cble.	—	75½*	——	Steel, com.	54	55⅛	411,200
Am. T. & T.	130⅞	128¾	20,500	Steel, pfd.	112⅝	112¾	22,225
B. R. T.	53¼	55	41,160	W. U. T.	65¼	70	11,250
Gen. Elec.	153½	160	8,100	West'h., com.	91¾	91¾	10,150
Int.-Met., com.	13¾	14½	44,450	West'h., pfd.	119*	125*	300

PHILADELPHIA.

	Nov. 23.	Nov. 30.	Shares sold.		Nov. 23.	Nov. 30.	Shares sold.
Am. Rys.	46*	46½	——	Phila. Elec.	11¾	11⅜	——
Elec. Co. of A.	10¾*	10¾	——	Phila. R. T.	22⅜	22½	——
Elec. Stor. B'ty.	41	43	——	Phila. Traction.	89	90	——
E. S. B'ty, pfd.	49*	49*	——	Union Traction.	49⅞	49½	——

CHICAGO.

	Nov. 23.	Nov. 30.	Shares sold.		Nov. 23.	Nov. 30.	Shares sold.
Chi. City Ry.	176*	176*	——	Chi. Tel. Co.	127*	130	——
Chi. Rys., Ser. 1.	110*	117	——	Met. El., com.	13*	13*	——
Chi. Rys., Ser. 2.	45	45	——	Nat'nal Carbon.	83*	83*	——
Com. Edison	107½	105¼	——	Nat. Carb., pfd.	113	113*	——
Chi. Subway	21¾	22	——				

BOSTON.

	Nov. 23.	Nov. 30.	Shares sold.		Nov. 23.	Nov. 30.	Shares sold.
Am. Tel. & Tel.	131	128¾	——	Mass. E. R., pfd.	58	60¼	——
Com'bind Tel.	122*	127	——	Mex. Tel.	3	3*	——
Gen. Elec.	154	159½	——	Mex. Tel., pfd.	5½*	5½*	——
Edison El. Ill.	250¼	251	——	N. E. Tel'p.	127*	126	——
Mass. Elec. Ry.	11¾	13	——	W. Tel. & Tel.	9⅛	9⅛*	——
				W. T. & T., pfd.	78½	78½*	——

*Last price quoted.
Shares sold are for week Nov. 23 to Nov. 28.

DIVIDENDS.

United States Leather Company, preferred, quarterly, 1½ per cent, payable Jan. 2.

Utah Copper Company, quarterly, 50 cents per share, payable Dec. 31.

Mackay Companies, common, quarterly, 1 per cent, payable Jan. 1.

Mackay Companies, preferred, quarterly, 1 per cent, payable Jan. 1.

Electric Light & Power Company, of Abington and Rockland, semi-annual, $4 per share, payable Jan. 1.

Puget Sound Electric Railway, semi-annual, $3 per share, payable Jan. 1.

Massachusetts Electric Company, preferred, quarterly, 1 per cent, payable Jan. 1.

Norfolk Railway & Light Company, semi-annual, 2 per cent, payable Dec. 5.

WESTINGHOUSE STOCKHOLDERS ACCEPT REORGANIZATION PLAN AND ELECT DIRECTORS.

The stockholders of the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., at a meeting Nov. 24, voted to increase the authorized capital stock of the company $10,000,000 and also adopted the substitute or modified plan for the readjustment of the debt of the company which is based upon the plan of the merchandise creditors. Regarding the meeting, the following official statement was issued by the company: "At the meeting held on Nov. 24 the stockholders increased the authorized capital stock of the company by $10,000,000, all assenting stock, and also adopted the substitute or modified plan for the readjustment of the debt of the company, which is based upon the merchandise creditors' plan. Of the $10,000,000 additional stock only between $2,000,000 and $3,000,000 is needed under the readjustment plan. The balance will be subject to issue by authority of the board of directors. The meetings have been adjourned until Nov. 30, when it is expected that the new board of directors and the proxy committee will be elected." At the meeting of stockholders on Nov. 30, the directors whose names were given last week were elected. The following proxy committee, also approved by the readjustment committee, the merchandise creditors' committee and the stockholders' committee, was also elected: Mr. James N. Jarvie, Mr. Jacob H. Schiff, Mr. Charles Francis Adams, Mr. Robert S. Smith and Mr. F. W. Roebling.

NORTH SHORE ELECTRIC ANNUAL REPORT.—The North Shore Electric Company, which operates central-station service in the suburban towns around Chicago, has issued its report for the year ending Sept. 30, 1908:

	Sept. 30, 1907.	Sept. 30, 1908.
Gross earnings	$565,890	$815,550
Expenses (including taxes and rental)	431,438	533,619
Net earnings	$234,452	$281,931
Bond interest	107,689	159,283
Surplus for year	$126,763	$122,648

The president, Samuel Insull, in his report to the shareholders, said: "To provide funds for the further equipment of the Blue Island and Waukegan stations and extension of the company's distribution system the outstanding stock was increased during the year by $530,000, and its first mortgage bonds were increased by $1,061,000. The new generating station at Waukegan and a new substation at Lake Bluff have both been placed in service and will greatly increase the company's ability to handle the rapidly growing business on the north shore from Glencoe to Waukegan. The operation of the new stations at Blue Island and Waukegan during the last year has thoroughly justified their construction and enabled the company to secure satisfactory power contracts with street and interurban railways and large industrial establishments." The following statement shows the company's connected business (exclusive of railway power business) for the past six years: Equivalent of 16-cp lamps, connected Sept. 30, 1903, $65,247; connected Sept. 30, 1904, $93,004; connected Sept. 30, 1905, $116,401; connected Sept. 30, 1906, $184,804; connected Sept. 30, 1907, $225,061; connected Sept. 30, 1908, $263,173.

BELL TELEPHONE BOND ISSUE.—The announcement is made this week that the American Telephone & Telegraph Company has sold $50,000,000 additional convertible 4 per cent bonds to a syndicate composed of J. P. Morgan & Company, Kuhn, Loeb & Company, Kidder, Peabody & Company and Baring Brothers & Company, making the total outstanding bonds of this company, convertible into stock, $150,000,000. The participating members of the syndicate which took the first $100,000,000 bonds in January, 1906, are permitted to subscribe for the new issue at a reported price of 92. About a year after the $100,000,000 bonds issued in January, 1906, were sold to a bankers' syndicate at about 94 or 94½, the company found it necessary to borrow further large amounts of money for improvements, extensions and other purposes. In January, 1907, it took steps to fund the existing floating obligations into $25,000,000 of three-year 5 per cent notes. The bankers, however, hesitated about the transaction, having still a number of instalments to pay on the $100,000,000 bonds which they bought the year before. It is reported that as a condition for taking the new notes the bankers obtained from the company a modification of the terms on which the bonds were taken—a proceeding which has few parallels in Wall Street. The contract price of the bonds was marked down 3 to 3½ per cent, to about 91. This, in effect, made the $25,000,000 notes cost $3,000,000 or $3,500,000 more, or, in effect, raised the interest on the three-year notes to 10 or 12 per cent. Bonds and stock have lately been active on the Exchange. The bonds have risen from 84¼ to 96⅝, and the stock from 101 to 132⅝ this year.

SUSQUEHANNA RAILWAY, LIGHT & POWER COMPANY.—The Susquehanna Railway, Light & Power Company, Lancaster, Pa., reports earnings as follows for the year ended June 30, 1908: Net earnings of subsidiary companies accruing to Susquehanna company, $413,315; earnings on securities held, $95,960; interest on loans to subsidiary companies, $33,433; interest on cash balance, $1,082; commissions and miscellaneous income, $7,690; total net earnings, $551,470. The deductions from net earnings include interest on the bonds of the United Gas & Electric Company amounting to $86,375, interest on the bonds of the Lancaster County Railway & Light Company amounting to $50,000, dividends on the preferred stock of the United Gas & Electric Company amounting to $58,605, dividends on the stock of the Lancaster County Railway & Light Company amounting to $50,000, making the total deductions from net earnings $244,980, leaving $306,499 available for dividends. The dividends paid on Sept. 1, 1907, and on March 1, 1908, amounted to $131,632, leaving an undivided surplus of $174,867. In presenting the report to the stockholders, George Bullock, president of the company, said that during the year a sum in excess of $1,000,000 was authorized and expended for extensions, additions and betterments to the various properties.

NEW YORK & NEW JERSEY TELEPHONE COMPANY.—Announcement was made on Nov. 25 by the New York & New Jersey Telephone Company, New York, of an issue of $5,047,000 additional capital stock, which is offered to stockholders at par in the proportion of one share of the new for five of the old. Rights to subscribe expire on Jan. 16, 1909, on which date payment of 50 per cent is required; of the balance one-half is payable on April 16 and one-half on July 6. The issue is to retire notes issued for construction and to provide for further necessary additions to the construction account.

MUTUAL TELEPHONE COMPANY PURCHASES HAWKEYE TELEPHONE PLANT.—The Mutual Telephone Company, Des Moines, Ia., has purchased the plant and holdings of the Hawkeye Telephone Company for $350,000. The system of the Hawkeye Telephone Company included 5000 miles of toll lines and 1100 miles of rural telephone lines and exchanges at Perry, Valley Junction, Indianola, Winterset, Guthrie Center, Panora, Greenfield, Stuart and Adel, Ia.

MASSACHUSETTS ELECTRIC COMPANIES DECLARES DIVIDEND.—The trustees of the Massachusetts Electric Companies, Boston, have voted to resume the dividends on the $20,557,400 preferred stock by a declaration of a dividend of 1 per cent. The last regular semi-annual dividend on the preferred was paid Jan. 1, 1905.

INCREASE IN MUNICIPAL LIGHT BONDS IN SEATTLE.—The finance committee of the City Council of Seattle, Wash., has recommended to the Council that the proposed issue of municipal electric light bonds be increased from $500,000 to $800,000. Citizens will vote on the proposed increase on Dec. 29.

EXTENSION OF MUNICIPAL LIGHTING PLANT.—The city of Pawnee, Okla., will issue $50,000 bonds to be used in the repair and extension of the electric light and water plant. M. H. Bretz is city clerk.

COMMONWEALTH EDISON COMPANY.—As a result of conferences held recently in Chicago, the following committee has been appointed to consider the organization of a company to control the Chicago City Railway, Chicago Railways, Commonwealth Edison Company, Northwestern Elevated Railroad, Chicago & Oak Park Elevated Railroad, Metropolitan West Side Elevated Railway, South Side Elevated Railroad, all of Chicago: J. J. Mitchell, Chauncey Keep, J. A. Spoor, Henry A. Blair, W. N. Eisendrath, Wallace Heckman and Samuel Insull. To correct any erroneous impression that might result from the publication of rumors, J. A. Spoor and Henry A. Blair have issued a statement over their signatures to the effect that "no plan has been formulated, and it is as yet wholly uncertain whether one can be formulated which will be satisfactory."

TRUCKEE RIVER GENERAL ELECTRIC COMPANY, SAN FRANCISCO, CAL.—W. P. Hammon and his associates of Boston have closed their option on the $3,000,000 capital stock of the Truckee River General Electric Company, the majority of which is held in escrow by the London-Paris National Bank. Mr. Hammon and his associates are understood to have agreed to pay $25 per share for the stock and interest at 6 per cent per annum from June 19, 1908, on all deferred payments. Of the purchase price $100,000 has been paid, $100,000 is due on Dec. 1, and the balance of the $1,500,000 necessary to complete the purchase of all the stock at $25 per share is to be paid in installments at stated intervals during 1909.

TOLEDO, ANN ARBOR & DETROIT RAILROAD.—The completed roadbed of the Toledo, Ann Arbor & Detroit Railroad, extending from the Ohio and Michigan line to Ann Arbor, Mich., and the other property of the company in Michigan were bid in at master's sale in Toledo on Nov. 16 for $60,000 by Mr. Curtiss M. Stendell and Mr. Valentine H. Sorghner, Chicago, representing a Chicago syndicate. The purchasers state that the road will be completed and that a portion of it will probably be in operation by February, 1909. An endeavor will be made to buy the property of the company in Ohio, but if the purchase cannot be concluded a new entrance to Toledo will be sought.

UNION ELECTRIC LIGHT & POWER COMPANY.—N. W. Harris & Company, New York, have purchased $3,000,000 of 25-year 5 per cent bonds of the Union Electric Light & Power Company, St. Louis, a subsidiary of the North American Company, and offer them for subscription at 99 and interest. The proceeds of the new issue will be used to retire an equal amount of collaterally secured short time notes maturing on Jan. 15, 1909. A report of the company for the year ended Sept. 30, 1908, is presented which shows as follows: Gross earnings, $3,006,844; operating expenses and taxes, $1,542,089; net earnings, $1,464,755; interest charges, $781,000; surplus, $683,755.

SUSQUEHANNA RAILWAY, LIGHT & POWER COMPANY.—The Susquehanna Railway, Light & Power Company reports as follows for the year ended June 30, 1908: Receipts from subsidiary companies, etc., $551,479; interest on bonds, dividends on stocks of subsidiary companies, $224,980; balance available for dividends, $396,409; dividends, $131,632; undivided surplus, $174,827. The company owns the capital stock of the United Gas & Electric Company and the Lancaster County Railway & Light Company, which control railway, light, power and gas plants in different parts of the United States.

WASHINGTON WATER POWER COMPANY.—A special meeting of the stockholders of the Washington Water Power Company, Spokane, Wash., will be held on Dec. 1, 1908, for the purpose of authorizing an issue of $15,000,000 30-year 5 per cent bonds, to be secured by a mortgage on all the property and franchises of the company. The capital stock of the company previously authorized is to be increased $1,003,260, 20 per cent of the present issue of $5,016,300.

COLORADO SPRINGS (COL.) ELECTRIC COMPANY.—Berton, Storrs & Griscom, New York, are offering the unsold portion of a block of $250,000 three-year 6 per cent debenture gold notes, dated Oct. 1, 1908, and due Oct. 1, 1911, but redeemable at any interest period at par and interest. The interest is payable April 1 and Oct. 1, at New York and Colorado Springs. The Colorado Title & Trust Company is trustee.

VALLEY HOME TELEPHONE COMPANY.—The Valley Home Telephone Company has been organized at Saginaw, Mich., to take over, it is said, independent telephone interests in northwestern Michigan, including the exchanges at Saginaw, Bay City and Flint. The authorized capital of the company is $2,500,000, divided into 25,000 shares.

GREENFIELD ELECTRIC LIGHT & POWER COMPANY.—The Massachusetts Gas Commission has approved an issue of $125,000 additional stock of the Greenfield Electric Light & Power Company, at par, to cancel an equal amount of outstanding obligations.

MONTGOMERY (ALA.) TRACTION COMPANY.—Control of the Montgomery Traction Company has passed from the Philadelphia syndicate which has owned and operated the property since December, 1905, to Mr. Richard Tillis, of Montgomery, and associates.

REPORTS OF EARNINGS.

	Gross Earnings.	Expenses.	Net Earnings.	Charges.	Surplus.
Aurora, Elgin & Chicago Railroad, Chicago, Ill.:					
October, 1908	$121,525	$67,041	$54,484	$27,731	$26,752
October, 1907	122,930	67,554	55,376	27,840	27,536
Detroit (Mich.) United Railway:					
October, 1908	619,490	412,650	206,840	133,379	73,461
October, 1907	613,249	413,695	199,554	133,432	66,122
Georgia Railway-Electric Company, Atlanta, Ga.:					
October, 1908	311,453	144,992	166,461	.....	.....
October, 1907	303,862	150,969	152,893	.....	.....
Illinois Traction Company, Champaign, Ill.:					
October, 1908	379,222	202,662	176,560	.....	.....
October, 1907	368,838	198,852	169,986	.....	.....
Lexington (Ky.) Interurban Railway:					
October, 1908	53,730	36,803	16,927	.....	.....
October, 1907	52,537	31,458	21,079	.....	.....
Rochester (N. Y.) & Eastern Rapid Railway:					
Year ended June 30, 1908	280,023	221,520	58,503	106,214	*47,711
Year ended June 30, 1907	258,982	168,963	90,019	120,114	*30,095
Schenectady (N. Y.) Railway:					
Year ended June 30, 1908	992,360	723,305	269,055	125,889	143,166
Year ended June 30, 1907	1,043,367	708,812	334,555	137,735	196,820
Toledo (Ohio) Railways & Light Company:					
October, 1908	218,263	192,982	98,280	71,953	26,327
October, 1907	220,787	122,320	98,471	67,533	30,937
Twin City Rapid Transit Company, Minneapolis, Minn.:					
October, 1908	554,166	265,893	288,273	138,667	149,607
October, 1907	515,178	255,587	259,590	132,642	126,949

*Deficit.

GENERAL NEWS

Construction News.

NOGALES, ARIZ.—The Arizona Mercantile Transportation & Smelter Company, of Chicago, is reported to be interested in an enterprise to build an electric railway from Phoenix, Ariz., to St. George's Bay. Work will commence on the construction of the railway as soon as concessions can be obtained from the Mexican Government.

RAVENDEN SPRINGS, ARK.—Plans are being considered to organize a company, with a capital stock of $75,000, to construct an electric railway seven miles in length.

ALAMEDA, CAL.—The Southern Pacific Company has commenced work on the construction of its power plant, which will furnish electrical power to operate the electric transportation system to be installed by the company in Alameda, Oakland and Berkeley. Oil will be used as fuel.

CALISTOGA, CAL.—The plant and franchise of the Calistoga Electric Light & Power Company was sold at a sheriff's sale Nov. 16 to Mr. Spiers for $2,000.

DOWNEY, CAL.—H. W. Hagerman, of San Bernardino, and J. R. Gordon are reported to have been granted a franchise to construct and operate an electric light and power plant in Downey.

DUNSMUIR, CAL.—The Siskiyou County Light & Power Company is reported to have purchased the plant and holdings of the Dunsmuir electric light plant owned by Herman Scherer.

FRESNO, CAL.—It is reported that the officials of the Fresno-Hanford Interurban Railway Company have decided to erect a power plant at Kingsbury to furnish electricity to operate its railway. The cost of the plant is estimated at $100,000.

GEORGETOWN, CAL.—Notice of appropriation of 200 cu. in. of water of Bear Creek, at what is known as Big Falls, has been filed by Norvall Douglass, Jr. The water power will be developed to generate electricity, which will be utilized for mining purposes.

RED BLUFF, CAL.—A. G. Simpson and William Elliott, of Chico, each have filed on 8000 cu. in. of water in Deer Creek.

RED BLUFF, CAL.—H. A. Tedford has filed notice of appropriation of 6000 cu. in. of water in North Battle Creek. Notice has also been filed by W. W. Wheeler of appropriation of 5000 cu. in. of water in South Battle Creek.

RED BLUFF, CAL.—The Northern California Power Company has commenced active operations in the vicinity of Manton and is now beginning work on a large ditch which is to bring the water from South Battle Creek to its power house, which is to be located about one mile above the Battle Creek Bridge. A machine and boiler shop is under construction, and the company will make the pipe to be used at the works. All the waters of the many tributaries to South Battle Creek will be utilized, as several ditches previously used for irrigation purposes have been purchased and the water turned back into the creek to increase the volume to be used in oprating one of the largest power plants in the state.

SAN DIEGO, CAL.—The City Council has awarded the Point Loma Railway Company a 25-year franchise to operate a street railway in Point Loma.

DENVER, COL.—The Continental Mines, Power & Reduction Company is planning to double the output of its plant. Henry I. Seamann is manager.

DENER, COL.—Plans are being prepared by the Northern Colorado Power Company for the construction of transmission lines in the northern part of the State, which will supply sufficient electrical power to pump water to irrigate 200,000 acres of land in the vicinity of Greeley, New Windsor and Fort Collins. The substation will be located at Windsor. Electrical energy will be transmitted from the Louisville power plant at 44,000 volts, 60 cycles, three-phase to the substation, where it will be transformed to 2300 volts for distribution. The cost of the work is estimated at $500,000. It is said that arrangements are being made to operate the new sugar factory in Windsor by electricity.

GREELEY, COL.—The Home Electric Light & Power Company is having plans prepared for enlarging its power station and extending its distributing system. The present station of the company is equipped with a gas producer and gas engine. Robert McF. Doble, Majestic Building, Denver, Col., is consulting engineer.

MIDDLETOWN, CONN.—Electric motors are being installed experimentally at the mills of Meech & Stoddard by the Middletown Electric Light Company. If they prove satisfactory, electricity will be used to operate the plant instead of steam power.

WHITNEYVILLE, CONN.—The Whitneyville Improvement Association, recently organized, has appointed a committee to solicit funds to establish a street lighting system. It has not yet been decided whether gas or electricity will be used.

WASHINGTON, D. C.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Dec. 15, for furnishing at the various naval stations and navy yards the following supplies: Mare Island, Cal., Schedule 606—one wattmeter and six transformers. New Orleans, La., Schedule 641—3000 ft. iron conduit and 150 conduit elbows, 600 ft. rubber-covered wire, 5200 ft. duplex rubber-covered wire, 30 direct-current multiple arc lamps, panel board and steel distribution cabinet, etc. E. B. Rogers is paymaster general, U. S. N.

AMERICUS, GA.—The City Council has decided upon municipal ownership and operation of the electric lighting and pumping plants for its water works, and has authorized the water committee of the Council to procure at once estimates of the cost of proposed plants. The city owns the water works system; about a year ago the city entered into a contract with the Americus Railway & Light Company to furnish electricity to light the city and to pump the water supply, the company agreeing to build a new power plant and electric railway. The terms of the contract have not been complied with and the City Council has declared the contract forfeited, and is now proceeding to establish a new water and light plant combined.

ROME, GA.—The citizens are considering the question of establishing a municipal electric light plant. J. Henderson Lanham has been appointed to investigate the matter.

THOMASTON, GA.—The City contemplates doubling the output of the municipal electric light plant, the cost of which is estimated at about $8,000. An election will be held Dec. 14 to vote on the proposition to issue $10,000 in bonds. W. C. Hartman is superintendent.

MOUNTAIN HOME, IDAHO.—The officers of the Crane Falls Power & Irrigation Company, of Cleveland, Ohio, have let the contract for the construction of a 3000-kw electric plant on Snake River at Crane Falls, work to begin Jan. 1.

PAYETTE, IDAHO.—The Idaho Light & Power Company has applied to the Council for a franchise. O. G. F. Mardhus, of Boise, is general manager of the company.

WEISER, IDAHO.—Bonds to the amount of $29,800 have been sold, the proceeds to be used for extension of the municipal electric lighting system and improvements to the water system. The city has recently closed a contract with the Idaho Light & Power Company whereby the latter is to furnish the city with electricity for lamps and motors, the service to begin Jan. 1, 1909.

CAIRO, ILL.—The City Council has granted the Cairo & St. Louis Railway Company a 20-year street railway franchise and a 50-year interurban franchise. As a result of the franchises having been granted, it is said that the Illinois Traction Company will purchase the street railway, electric lighting and gas plants of the Cairo Electric & Traction Company from the Halliday interests and will commence at once the construction of an interurban railway to Mound City or Mounds. The interurban railway is chartered to extend from Cairo to St. Louis.

CHICAGO, ILL.—Arrangements are being made for the construction of a new plant for the Featherstone Foundry & Machine Company, Chicago, Ill., to be located at Ninety-fifth Street and Cottage Grove Avenue. The new plant will be operated by electricity, which will be purchased.

DECATUR, IND.—The Ft. Wayne & Springfield Railway Company contemplates awarding contracts for the construction of a 12-mile extension in the near future.

HAGERSTOWN, IND.—The trustees of the municipal electric light plant contemplate the construction of a new power plant in connection with the municipal electric lighting system.

LAFAYETTE, IND.—Plans are being made by the Ft. Wayne & Wabash Valley Traction Company to remodel its power house at Lafayette. C. D. Emmons is general manager.

POSEYVILLE, IND.—The Poseyville Light & Power Company contemplates extending its transmission lines to Cynthiana, Ind. M. T. Dilger is manager.

AUDUBON, IA.—The citizens have voted to grant the Audubon County Telephone Company a franchise to erect a telephone system in Audubon.

CEDAR RAPIDS, IA.—A new 1500-kw turbo-generator is being installed in the power house of the Cedar Rapids & Iowa City Railway & Light Company.

CLINTON, IA.—Plans are being made by the Chicago & Northwestern Railroad Company for the construction of a large power house, to be located on the bank of the Mississippi River, south of the railroad bridge, work on which will begin early in the spring. The plant will furnish electricity for lamps, heat and power for the bridge, interlocking plants, switches, depot and other buildings. For further information address general manager of the Chicago & Northwestern Railway Company, Chicago, Ill.

GRISWOLD, IA.—The Griswold Milling & Light Company is planning to install an alternating-current generator during the next year. The company proposes to furnish electricity to two other towns and to farmers in outlying districts. I. W. Daily is superintendent.

MURRAY, IA.—An election will be held Dec. 15 to vote on the proposition of granting a franchise to Mr. Miles to install an electric light plant in Murray.

WAVERLY, IA.—The town has authorized a bond issue of $30,000, the proceeds to be used to rebuild the municipal electric light and water plant, recently destroyed by fire.

BELOIT, KAN.—The contract for furnishing and installing a Corliss condensing engine direct connected to a 160-kw generator, and also a 130-kw, belt-driven generator for the municipal electric light plant has been awarded to Hoover, Owens & Rentschler, of St. Louis, Mo. The Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., will furnish 20 arc lamps and other electrical equipment. Burns & McDonnell, Scarritt Building, Kansas City, Mo., are the engineers.

COUNCIL GROVE, KAN.—The Council Grove Ice Company is making arrangements to install an electric light plant in connection with its ice plant. The equipment will consist of two units for a 24-hour service. Machinery for the plant has not yet been purchased.

ELLIS, KAN.—On Nov. 10 the citizens voted to issue from $40,000 to $50,000 in bonds, the proceeds to be used for the construction of an electric light plant and water works system. The W. K. Palmer Company, Dwight Building, Kansas City, Mo., has charge of the engineering work.

JUNCTION CITY, KAN.—The directors of the Junction City Electric Light & Ice Company have decided to make extensive improvements to its system, to cost about $100,000. The company is contemplating the installation of two 250-hp boilers and new street cars and will make other improvements.

PARSONS, KAN.—A franchise has been granted to Cyrus E. Meade, of Toledo, Ohio, to build a street railway in Parsons.

SALINA, KAN.—The citizens are considering the question of municipal ownership of the light, heat and power plant and water works system.

TOPEKA, KAN.—The City Council has passed an ordinance calling for an issue of $40,000 in bonds, the proceeds to be used for the new electric light plant.

GREENVILLE, KY.—The directors of the Greenville Light & Power Company have voted to issue $12,000 in bonds, the proceeds to be used to extend its lighting circuits.

ALEXANDRIA, LA.—The Alexandria Electric Railway Company will place contracts for overhead material for a two-mile extension within two weeks. I. B. White is superintendent.

BANGOR, MAINE.—It is reported that the Maine Central Railroad Company is considering the question of changing the motive power of its Mount Desert branch from steam to electricity. It is proposed to equip the present branch from Bangor to Ellsworth, to be operated by electricity, and build a new road from Ellsworth to Bar Harbor. Electricity for operating the road would be furnished from the power plant of the Bar Harbor & Union River Power Company, located on the Union River, at Ellsworth.

NORTH ADAMS, MASS.—Announcement has been made that the controlling interests of the North Adams, Adams, Williamstown and Stamford lighting companies has been purchased by the Massachusetts Lighting Company, of which Arthur E. Childs, of Boston, Mass., is president. The Massachusetts Lighting Company will assume control of the four companies not later than Dec. 15.

ESCANABA, MICH.—Arrangements are being made by the Escanaba Power Company to commence work on the construction of a water power project on the Escanaba River near Flat Rock.

LONG PRAIRIE, MICH.—Plans are being considered by the Sauk Valley Telephone Company to extend its telephone system to Long Prairie.

ALBERT LEA, MINN.—The Albert Lea Light & Power Company is considering plans for increasing the output of its plant. It will install an engine, boiler and generator and other auxiliary apparatus in its power station. About five miles of transmission line will be erected.

FERGUS FALLS, MINN.—A committee has been appointed by Mayor Hille to investigate the question of installing a municipal telephone system.

MAPLETON, MINN.—Extensive improvements are contemplated to the local telephone system.

SWANVILLE, MINN.—The Elmdale Rural Telephone Company has been granted a franchise in Swanville.

PASS CHRISTIAN, MISS.—The City Council will consider the question of granting a franchise to light the city by electricity.

CHILLICOTHE, MO.—Bids will be received by H. I. Spence, city clerk, for the construction of a gas and electric light plant for street and commercial lighting, with day service in Chillicothe, on the basis of a 15-year franchise. The city has a population of 8000.

COLUMBIA, MO.—J. W. Grain and others have applied to the City Council for a franchise to construct telephone lines in connection with the erection of rural telephone lines between Columbia and other points south.

ELSBERRY, MO.—Contracts for the construction of the municipal electric light plant have been awarded as follows: Construction of power house, to J. W. M. Palmer, of Elberry, for $1,170; steam power plant complete, to the Brownell Company, of Dayton, Ohio, for $3,288, and to the Allis-Chalmers Company, Milwaukee, Wis., for electrical equipment, for $2,052. The contract for pole line supplies has not yet been awarded. W. A. Fuller, Chemical Building, St. Louis, Mo., is consulting engineer.

JEFFERSON BARRACKS, MO.—Bids will be received by Captain O. W. Bell, quartermaster, Jefferson Barracks, Mo., until Dec. 22, for a complete electric wiring system, including the following items: Wiring buildings, constructing pole lines, furnishing electric fixtures, transformers and apparatus. Proposals will also be received for furnishing electrical energy for lighting at this post. Further information will be furnished on application to the above-named office.

JOLIET, MONT.—Norman S. Poole is reported to be interested in a project to establish an electric light plant in Joliet.

MILES CITY, MONT.—Arrangements are being made by the independent telephone company to install its system in this city in the near future.

RUSHVILLE, NEB.—D. W. Ferree is planning to install an electric light plant in this town.

MORRISTOWN, N. J.—The Morris County Traction Company has been granted a franchise by the Board of Freeholders to construct its railway on the county roads in Hanover Township.

TUCKERTON, N. J.—The Tuckerton Manufacturing Company contemplates installing an electric light plant, and may submit a bid for lighting the streets of the town by electricity, instead of gas.

BERGEN, N. Y.—Plans for the construction of a municipal electric light plant are being prepared by A. S. Crocker, Mechanics' Institute, Rochester, N. Y., to be erected in Bergen. Equipment of the plant has not yet been fully decided upon; two horizontal tubular boilers and two direct-connected, steam-engine-driven generators will be installed.

BROADALBIN, N. Y.—The Public Service Commission has granted the Broadalbin Electric Light & Power Company permission to issue $42,500 in capital stock and bonds to the amount of $10,000, the proceeds to be used to pay present obligation of the company, amounting to about $13,000, and the remainder for the construction of a dam, power house, equipment and transmission lines.

BROOKLYN, N. Y.—Bids will be received by John H. O'Brien, commissioner water supply, gas and electricity, 13 Park Row, New York, N. Y., until Dec. 7 for furnishing, installing, maintaining and reserving for use of the high pressure fire service all apparatus and equipment necessary for generating and transmitting 1830 kw, three-phase, 25-cycle, 6600-volt electrical energy and furnishing and delivering this energy under the terms of this contract from Jan. 1, 1909, to Dec. 31, 1909, inclusive, at each of the high pressure fire service pumping stations located in the Borough of Brooklyn at Furman and Joralemon Streets and at Willoughby and St. Edwards Streets. Blank forms may be obtained at the office of the department, 1310 Park Row Building, New York City.

BUFFALO, N. Y.—The committees on finance of the Board of Aldermen and Board of Supervisors have voted to install an electric lighting system in the city and county hall building, in accordance with plans prepared by J. J. O'Leary, of Buffalo, N. Y. The plans include the erection of 22 bronze standards supporting 500-cp lamps. The cost of the work is estimated at $75,000, for which bids are now being received by the Board of Trustees of the city and county hall.

CARTHAGE, N. Y.—The citizens on Nov. 24 voted to appropriate $600 to light the street of the village with electricity. It is expected that S. R. Cleveland, of Watertown, N. Y., who was recently granted a franchise to erect an electric plant in the village, will soon commence work on the installation of the system.

GENEVA, N. Y.—The Common Council will at its next meeting decide whether the city will renew its electric lighting contract with the Geneva-Seneca Electric Company or construct a municipal pole line at an estimated cost of $20,000 and operate its own lighting plant.

NEW YORK, N. Y.—It is reported that the New York Edison Company contemplates the construction of a large central station at 201st Street, New York, N. Y.

NEW YORK, N. Y.—The New York & New Jersey Telephone Company has increased its capital stock by $5,047,000, the proceeds to be used to retire notes issued for construction funds and to provide for new construction.

NEW YORK, N. Y.—Bids will be received by the Department of Public Charities, foot of Twenty-sixth Street, New York, N. Y., until Dec. 7 for providing all materials and labor for the cooking equipment, including refrigerators, gas and electric fixtures, etc., in the nurses' home for the Metropolitan Hospital at Blackwell's Island, New York, N. Y. Robert W. Hebberd is commissioner.

NEW YORK, N. Y.—The New York, New Haven & Hartford Railroad Company has applied to the Public Service Commission for permission to equip its suburban division from 129th Street and the Harlem River to New Rochelle, where it joins the main line. The company states that it proposes to finance the intended construction from the proceeds of an issue of $15,000,000 in bonds, known as the New York, New Haven & Hartford Railroad Company-Harlem River & Port Chester first mortgage four per cent gold bonds.

NEW YORK, N. Y.—Bids will be received by John H. O'Brien, commissioner of water supply, gas and electricity, 13 Park Row, New York, N. Y., until Dec. 7 for furnishing and maintaining electric lamps for lighting streets, avenues, public buildings, parks and public places from Jan. 1, 1909, to Dec. 31, 1909, inclusive, in the City of New York, including the Boroughs of Manhattan, Bronx, Queens and Richmond. Separate bids will be received at the same time and place for lighting the streets, avenues, public buildings, parks and public places in the Borough

of Brooklyn. Blanks may be obtained at the office of the department, Room 1319, Park Row Building, New York, N. Y.

NEW YORK, N. Y.—Sealed proposals will be received by John H. O'Brien, commissioner of water supply, gas and electricity, 13 Park Row, New York, N. Y., until Dec. 7 for furnishing, installing and maintaining and reserving for use of the high pressure fire service all apparatus and equipment necessary for generating and transmitting 3250 kw, three-phase, 6600-volt, 25-cycle electrical energy and furnishing and delivering this energy under the terms of this contract from Jan. 1, 1909, to Dec. 31, 1909, inclusive, at each of the high pressure fire service pumping stations located in the Borough of Manhattan, at Oliver and South Streets and at Gansevoort and West Streets. Blank forms may be obtained at the office of the department, 1310 Park Row Building, New York City.

OGDENSBURG, N. Y.—J. Wesley Allison, of Morrisburg, Ont., and Leslie Shaw, former Secretary of the Treasury, are reported to be interested in a project for the construction of an electric railway from Ottawa, Ont., to a point on the New York & Ottawa Railway, a distance of 75 miles, giving connection with Morrisburg on the St. Lawrence River.

LEXINGTON, N. C.—C. A. Hunt, Jr., is interested in a project to organize a company, with a capital stock of $125,000, to construct a mill for manufacturing colored cloth. Electricity will be used for motive power if a satisfactory price can be secured; if not a steam plant will be installed. About 350 hp will be required.

THOMASVILLE, N. C.—The Thomasville Light & Power Company recently reorganized, has increased its capital stock to $20,000. J. W. Lambreth is president.

HETTINGER, N. D.—The Northern Telephone Company has filed a petition for a franchise to erect a telephone system in Hettinger.

MOUNTAIN, N. D.—The Edinburg & Gardar Telephone Company contemplates establishing a telephone exchange in Mountain.

CUYAHOGA FALLS, OHIO.—H. von Schon, of Detroit, Mich., consulting engineer, has been engaged to prepare plans for a hydro-electric development of the power of Cuyahoga Falls, Ohio.

FINDLAY, OHIO.—New specifications have been adopted by the City Council and the Board of Public Service has been instructed to advertise for bids for lighting the streets of the city. The Toledo, Urbana & Interurban Railway Company is reported to have entered into an agreement to reduce its rates for electricity for lamps from 10 to 8 cents per kw-hour, and also agrees that no meter rates shall be charged for commercial lighting.

LOGAN, OHIO.—The proposition to erect a municipal electric light plant in Logan was defeated at a recent election. The city officials have awarded a contract for lighting the city to the Logan Light & Power Company, which now has a plant under construction. Mr. Wagenhauls is manager.

HOBART, OKLA.—Owing to the alleged exorbitant rates charged by the Hobart Electric Light & Power Company the citizens are circulating a petition asking the City Council to take steps to establish a municipal electric light plant.

CONDON, ORE.—The Wasco Electric & Water Power Company has filed maps and definite location of dam sites and power stations on the Deschutes and John Day Rivers with the state engineer. Arrangements will soon be made for financing the project.

PORTLAND, ORE.—The plants and lines of the Pacific Telephone & Telegraph Company of Coos and Curry Counties have been purchased and taken over by the Coos Bay Home Telephone Company. The company is planning to make extensive improvements to plants and service. R. T. Durette is manager.

PORTLAND, ORE.—Transmission lines are being erected by the Portland Railway, Light & Power Company to the lower peninsular to furnish electricity to the Swift packing plant and to operate the draw spans of the new Spokane, Portland & Seattle Railway bridges across the Oregon Slough. The Portland company has contracts to furnish electrical energy for operating the interurban railway systems of the Oregon Electric Railway and the United Railways Companies.

PORTLAND, ORE.—Arrangements are being made by the Portland Railway, Light & Power Company for commencing work on the construction of its conduit system in the city of Portland. It is expected to have its wires placed in underground conduits in the business districts by Sept. 1, 1909. The cost of the system is estimated at $1,250,000. The substation at Seventh and Alder Streets will be dismantled and a large storage battery plant installed at a cost of about $150,000. A new generator has been installed in the Cazadero plant to replace the one destroyed by fire last June. A third generator will soon be installed which will restore the equipment of the plant to its former capacity. It is said that orders will soon be placed for another 5000-hp turbine water wheel and a 4000-kw generator to be installed in the Cazadero station. B. S. Josselyn is president.

VALE, ORE.—R. C. Carter, of Boise, Idaho, has purchased the controlling interest of the Vale Light & Power Company, and proposes to remodel the plant and install new machinery. The company has been reorganized, Mr. Carter having been elected president.

BLOOMSBURG, PA.—It is reported that arrangements have been completed for the consolidation of the United Gas & Electric Light Company and the Irondale Electric Light Company, of Bloomsburg, Pa.; the Standard Gas Company, of Danville, Pa.; the Berwick Electric Light Company, of Berwick, Pa.; the Columbia & Montour and the Danville & Bloomsburg Electric Railway Companies under the name of the Columbia Public Uses Corporation. The new company will be capitalized at $1,000,000. It is understood that the local power plants in the different towns will eventually be discarded, and electricity for operating the electric lighting and power systems and street railways will be furnished from the large power plant of the Harwood Electric Power Company, located near Hazleton, now under construction. It is also stated that the equipment of the electric railways will be greatly improved.

COALDALE, PA.—At a recent election the citizens voted to issue $35,000 in bonds, the proceeds to be used to establish a municipal electric light plant and improvements to the sewer system.

FORD CITY, PA.—An election will be held Dec. 17 to vote on the proposition to issue $16,000 in bonds, the proceeds to be used to establish a municipal electric light plant.

KITTANNING, PA.—The question of installing a new electric light plant in the Borough of College Hill is now under consideration.

MILL CREEK, PA.—Bids will be received by the Directors of the Poor at the city office, Penn Building, Erie, Pa., until Dec. 10, for furnishing and installing two steam engines and piping; two electric generators and switchboard, and also material and labor for wiring buildings and grounds of the Erie County Alms House in Mill Creek Township, Pa. Plans can be seen at the city office. Specifications will be furnished on application. Fred C. Momeyer is secretary.

MAYAGUEZ, P. R.—The Mayaguez Sugar Company has installed an electric light plant at its works at a cost of more than $6,000. The plant was installed under the supervision of Thomas C. Vera.

SAN GERMAN, P. R.—An electric light plant has been installed in the residence of Juan Maria Palmer by Thomas C. Vera. The plant will furnish electricity to light the residence and grounds.

CHESTER, S. C.—Arrangements are being made to equip the Springstein Mills to be operated by electricity. About 750 hp will be needed.

CHESTER, S. C.—Plans are being made to equip the machinery of the Eureka Cotton Mills for electrical drive. About 750 hp will be required.

LANCASTER, S. C.—The Lancaster Cotton Mills are to be operated by electrical power, using about 2500 hp.

YANKTON, S. D.—The Yankton Telephone Company is preparing to erect a new telephone exchange.

BURNS, TENN.—A. L. M. Johnson and A. D. Clark are interested in a project to establish a local telephone company to erect telephone lines in Burns and to extend the system throughout the county.

McKENZIE, TENN.—The citizens are considering the question of establishing an electric lighting system in the town, for which estimates of the cost are now being made. For further information address the city clerk.

CUERO, TEX.—The Cuero Light & Power Company is rebuilding its electric plant, which was destroyed by fire. William M. Ratcliffe is president and manager.

GOLIAD, TEX.—The Goliad Water & Light Company, it is reported, has decided to install an electric light plant in connection with its water works system.

HUBBARD CITY, TEX.—Plans are being prepared by the Union Central Light & Ice Company for additions and improvements to its plant, the cost of which is estimated at $10,000. Equipment, including engines, boilers, dynamos and wire will be required. W. A. Bass is president.

OGDEN, UTAH.—At a meeting of the Chamber of Commerce held Nov. 18 a resolution was adopted requesting the City Council to exercise its rights in establishing electric light rates in Ogden, as provided by the statutes of the State, the charter of the city and the decision of the Supreme Court. It also went on record as favoring a municipal electric light plant, and urged the immediate action of the Council in utilizing water owned by the city for that purpose.

HOT SPRINGS, VA.—It is reported that Mrs. O. H. P. Belmont contemplates installing an electric light plant at Belmont Park, a new suburb of about 250 acres. J. T. McAllister is legal representative.

CASTLETON, VT.—The Rutland Railway, Light & Power Company has recently installed a 50-hp motor at the Jones Slate Company's works at Castleton.

WALLINGFORD, VT.—A canvass made by a representative of the Rutland Light & Power Company recently showed a demand for about 1000 incandescent electric lamps. The manufacturing plants will use about 200 hp. The cost of the proposed transmission line to be erected by the company from Rutland to Wallingford is estimated at about $10,000.

NORFOLK, VA.—Announcement has been made that the New York, Philadelphia & Norfolk Railway will install a telephone system to replace the present telegraph system for dispatching trains.

DAYTON, WASH.—A franchise has been granted to J. H. Spartin and John Broyles to erect and operate telephone lines in Columbia County.

PORT ORCHARD, WASH.—The County Commissioners have granted a franchise to the Island Telephone Company to erect a telephone system.

SEATTLE, WASH.—Application has been made to the County Commissioners by Eben Green and others for a franchise to erect telephone lines over certain highways in Kings County.

SEATTLE, WASH.—The City Council is considering the question of increasing the electric light plant and water works system and increasing

the proposed bond issue from $500,000 to $800,000. It is proposed to construct another dam about a mile and a half below the present dam on Cedar Creek, at an estimated cost of between $100,000 and $200,000; also to install a fifth water wheel and generator at the power plant. L. B. Youngs is superintendent of the municipal electric light plant and R. H. Thomson is city engineer.

SEATTLE, WASH.—The Pacific Coast Light & Power Company has commenced condemnation proceedings for acquirement of land and ascertainment of damages to the land of the Muckleshoot Indians, along White River. The company wishes to divert a large portion of the flow of White River, to be conveyed by canal to Lake Tapps, Crawford Lake, etc., in Pierce County, thence to Stuck River, where a power-house will be located. The company will supply electricity for lamps and motors to various portions of the State of Washington.

MILLVILLE, W. VA.—Application has been made to the Jefferson County Court by the Winchester & Washington City Railway Company for a franchise to extend its electric transmission lines from Millville to Bakerton, W. Va., to furnish electricity at the stone quarries at that place.

DORCHESTER, WIS.—Messrs. Lapp & Sturner are making arrangements to extend their telephone lines.

SOUTH WAYNE, WIS.—Arrangements are being made by the South Wayne Telephone Company to install a new switchboard.

McLEOD, ALB., CAN.—A by-law is being prepared authorizing the expenditure of $35,000 for additions to the municipal power plant. For further information address E. F. Brown.

MONTREAL, QUE., CAN.—The City Council has made an offer to the Montreal Light, Heat & Power Company for a 10-year contract, to date from Jan. 1, 1909, on the following terms: Arc lamps at $75 per annum per lamp; $36 each per year for 65-cp incandescent lamps, and $24 each per year for incandescent lamps of 32 cp, and nine cents per kw-hour for electricity for lighting the municipal buildings.

FERNIE, B. C., CAN.—Tenders addressed to A. A. Sharley, acting city clerk, will be received until Dec. 15 for the installation of a 260-hp gas producer plant, providing a satisfactory arrangement can be made with the Crow's Nest Pass Electric Light & Power Company. Plans and specifications may be seen at the municipal offices in Fernie.

VICTORIA, B. C., CAN.—The city is seeking authority from the Provincial Government for permission to generate and distribute electrical power. For further information address W. W. Northcote.

WINNIPEG, MAN., CAN.—The City Council has decided to construct a power plant on the Winnipeg River Rapids, 40 miles east of Winnipeg, where electrical power will be generated and transmitted to the city. Contracts involving an expenditure of about $1,500,000 will be awarded at once.

WINNIPEG, MAN.—Tenders will be received at the office of M. Peterson, secretary of the Board of Control, Winnipeg, Man., addressed to the Chairman of Board of Control, until Feb. 22, 1909, for furnishing and the erection of turbine pump with electric motor for the city water works. Specifications and forms of tender, with conditions governing the bids as prescribed by the city by-laws, may be obtained at the office of H. N. Ruttan, city engineer, Winnipeg, Man.

WINNIPEG, MAN., CAN.—Bids will be received at the office of M. Peterson, secretary of Board of Control, Winnipeg, Man., addressed to the Chairman of the Board of Control, until Dec. 28 for the construction of the general works and for the supply and erection of various portions of a transmission line between Point du Bois and Winnipeg, in connection with the Point du Bois hydro-electric development. Copies of instructions to bidders, plans, specifications and form of tender may be obtained at the office of the power engineer, Carnegie Library Building, Winnipeg, Man., and also at the offices of Smith, Kerry & Chace, Confederation Life Building, Toronto, Ont. Individual tenders will be received for the work as follows: 4, General works at Point du Bois; 14, erection of transmission line; 15, steel towers; 17, electric transmission cable. As a further alternative, tenders may include or group together one or more of the above items, providing that they have also tendered for the individual items of such group.

QUEBEC, QUE., CAN.—The plant and holdings of the North River Power Company have been purchased and is now operated by H. W. Robertson, St. Andrews East, Que.

Company Elections.

JORDAN, MINN.—At the annual meeting of the Jordan Electric Light & Heating Company the following-named officers were elected: F. J. Leonard, president; Peter Hilgers, vice-president; S. L. Sly, secretary, and John E. Casey, treasurer.

New Industrial Companies.

THE AMERICAN ELECTRICAL COMPANY, of East St. Louis, has filed articles of incorporation, with a capital stock of $2,500. The incorporators are E. M. Evens, E. Tozier and D. E. Keefe.

THE NATIONAL TUNGSTEN LAMP COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $1,000. The directors are: Thomas F. Farrell, Joseph J. Schmidt and Harry G. Anderson.

THE GRANT FLAMING ARC LAMP COMPANY, of Chicago, Ill., has filed articles of incorporation, with a capital stock of $10,000, and proposes to manufacture electrical appliances for lighting and heating. The incorporators are A. J. Lester, J. D. Ferguson and L. M. Greenlaw.

THE SUN ELECTRIC ARC LIGHT COMPANY, of New York, N. Y., has been incorporated with a capital stock of $25,000 to manufacture and deal in electric arc lamps, gas and electric fixtures. The incorporators are: J. William Hill, Joseph Biber and Louis Riesz, all of New York, N. Y.

THE WASATCH ELECTRIC SERVICE COMPANY, of Salt Lake City, Utah, has been incorporated, with a capital stock of $20,000 and proposes to deal in dynamos, motors and electrical supplies and will act in the capacity of hydro-electric engineer for the construction of water-power plants.

THE GREEN MOUNTAIN ELECTRIC COMPANY, of Burlington, Vt., has been organized, with a capital stock of $25,000, for the purpose of constructing electric and gas plants and dealing in all kinds of supplies and doing general engineering and contracting business. The incorporators are: E. E. Larabee, O. M. Barber, E. P. Broughton, of Bennington, Vt.; H. D. Larabee, of Montpelier, Vt.; F. W. Nichols, of Barre, Vt., and J. E. Davidson, of Montpelier.

THE MINNEAPOLIS ELECTRIC MOTOR COMPANY, of Minneapolis, Minn., has been incorporated, with a capital stock of $50,000, to manufacture and deal in electrical apparatus, appliances and machinery and fixtures of all kinds; also to engage in general engineering, manufacturing and mechanical construction and construction and equipment of electrical power plants and erection and equipment of telephone systems, etc. The incorporators are: Walter H. Vilett, John W. Helm, John M. Zessman, all of Minneapolis, Minn.

New Incorporations.

CRAGS, COL.—The Crags & Canon Railway Company has been chartered to build an electric railway from Crags to Eldorado Springs, thence to Boulder. The capital stock of the company is $300,000 and the incorporators are: George F. Keller, Fort Wayne, Ind.; L. B. Bradley, Chicago, Ill.; G. A. Brink, D. C. Nevin and N. S. Williams, of Denver, Col.

DOVER, DEL.—The Rector Light Company has been incorporated with a capital stock of $20,000 by W. E. Allen, E. J. Forhan and H. P. Jones, of New York, N. Y.

CLARKSVILLE, GA.—The Clarksville Railway Company has been incorporated with a capital stock of $10,000. The incorporators are E. S. Hunnicutt and Robert McMillan.

OCOYA, ILL.—The Pike Township Telephone Company has filed articles of incorporation, with a capital stock of $3,900. The incorporators are C. V. Richardson, Fred Fisher and J. H. Balbach.

PEORIA, ILL.—The Peoria & Galesburg Railway Company has been incorporated with a capital stock of $100,000 to construct a railway from Peoria to Galesburg and from Peoria to Canton. The directors are: D. M. Mayer, Arthur C. Black, S. F. Atwood, of Peoria, Ill.; William K. Boone, of Lima, Ohio, and H. T. Dick, of Chicago, Ill.

CLARINDA, IA.—The Clarinda & Bethesda Telephone Company has filed articles of incorporation of $1,000.

PARK, KAN.—The Park Telephone Company has been incorporated, with a capital stock of $10,000.

SAGINAW, MICH.—The Valley Home Telephone Company has been organized to take over the independent telephone interests in the northeastern part of Michigan, including the exchanges at Saginaw, Bay City and Flint. The company is capitalized at $2,500,000, and the directors are: Fred Woodwarth, E. T. Carrington, George E. Wedthoff and F. W. Kessler, all of Bay City, Mich.; John L. Jackson, John F. Brand, C. O. Trask and John J. Speed, of Saginaw; R. B. McPherson, of Howell, Mich.; James B. Gibbs, of Ithaca, Mich., and Charles E. Liken, of Sebawaing, Mich.

UNION, MO.—Articles of incorporation have been filed for the American Light & Power Company by N. W. McCurdy, C. P. Reinhard, A. E. Reinhard and L. W. McCurdy. The company is capitalized at $10,000 and proposes to generate and distribute electricity in Franklin County.

MARYSVILLE, MONT.—The Marysville Rural Telephone Company has been incorporated to erect a telephone line from Marysville to Canyon Creek and to Silvers or Johns.

CLARKSON, NEB.—The Western Star Telephone Company has been incorporated with a capital stock of $600 by Anton Rusicka and others.

HOMER, NEB.—The Farmers' Telephone Company has been organized and the following officers elected: C. Eriksen, president; William Blessing, secretary, and Louis Knudson, treasurer.

LINCOLN, NEB.—Articles of incorporation have been filed for the Cottonwood Grove Mutual Telephone Company, with a capital stock of $700, by John Henry, J. H. Hover and others.

LA FARGEVILLE, N. Y.—The La Fargeville Electric Light Company has been incorporated with a capital of $2,000.

BELFIELD, N. D.—The Belfield & Northwestern Telephone Company has filed articles of incorporation, with a capital stock of $5,000. The incorporators are: R. C. Davis, O. F. Olson, E. O'Connor and others, of Belfield, N. D.

HARRISVILLE, OHIO.—The People's Telephone Company has been organized with John Seebert as chairman and Walter Toland, secretary.

CARNEGIE, OKLA.—Articles of incorporation have been filed for the Carnegie Telephone Company, with a capital stock of $10,000, by G. O. Hall, W. F. Pevey and Mrs. M. Hall.

GRANTS PASS, ORE.—The Josephine County Irrigating & Power Company is being organized by H. L. Gilkey, of Grants Pass, Ore.; John Christie, G. H. Garner, E. E. Blanchard, O. S. Blanchard, R. Thomas and George A. Himilton for the purpose of irrigating about 20,000 acres of land belonging to the incorporators in Josephine County.

PRINEVILLE, ORE.—The McKay Creek Telephone Company has been formed in Prineville with the following named officers: R. M. Poweli, president; J. T. Moore, vice-president, and J. A. Seabury, secretary and treasurer.

CHAMBERSBURG, PA.—The Falling Spring Telephone Company has been organized to construct and operate a telephone line between Stoufferstown and Falling Spring. The officers of the company are: David Metz, president; John S. Wiles, vice-president, and Jacob S. Stoner, secretary.

IRWIN, PA.—The Farmers' Interurban Telephone Company has been organized for the purpose of erecting a telephone line from Irwin to Arona. The officers of the company are: George W. Painter, president; Edward Whitehead, vice-president; W. H. Taylor, secretary, and L. B. Gongaware, treasurer.

LEWISTOWN, PA.—The Lewistown Rural Telephone Company has been chartered, with a capital stock of $5,000.

PITTSBURG, PA.—The Banksville & West End Street Railway Company has been organized to construct and operate a street railway from Banksville to the dividing line of Union and Scott Township. W. E. Kusen, A. J. Schmidt, C. August Steutz, W. P. Heckman and J. D. C. Miller are interested in the project.

MODENA, UTAH.—The Goldflake Gold Mining & Power Company has been organized with a capital stock of $250,000. The company proposes to install a 600-hp electric plant at Modena and extend the transmission lines to the properties of Gold Springs. The plant will be operated by gas engines and will cost about $75,000. The officers of the company are: Charles Short, president; C. H. Kleinbeck, vice-president; H. R. Elliott, secretary and treasurer.

ARBOVALE, W. VA.—The Arbovale Mutual Telephone Company has been chartered, with a capital stock of $2,000, by S. B. Hammond, of Arbovale, W. Va.; E. A. Hudson, F. H. Warwick, L. H. Moomaw, J. H. Hudson and John Hevener, of Green Bank.

BARTON, WIS.—Articles of incorporation have been filed for the Barton Rural Telephone Company, with a capital stock of $300, by Henry Albright, Frank Mueller and William Luenberger.

LEBANON, WIS.—The Lebanon Telephone Company has been incorporated, with a capital stock of $10,000, by Henry C. Uttech, August H. Haas and August C. Neitzel. Post office address, Watertown, Wis.

HEDLEY, B. C., CAN.—The Hedley Power & Development Company has been formed to supply electricity to the mines. Application has been made for 2000 cu. in. of water from the Simalkameen River, and a site for the plant has been selected. L. H. Patton, of Hedley, B. C., is secretary and treasurer.

DUBLIN, ONT., CAN.—The McKillop, Logan & Hibbert Telephone Company has been organized, with a capital of $15,000. The provisional directors are: A. V. H. Mitchell, of Dublin, Ont.; W. W. Saddler and J. Norris, of Hibbert Township.

Legal.

FAILURE TO KEEP CURRENT TURNED OFF WHILE ELECTRIC LIGHT WIRES ARE BEING REPAIRED.—An action was brought against an electric light company to recover damages for the death of a lineman who was killed while at work on the wires of the company. The man had notified the power house by means of a public telephone not controlled or operated by defendant, that he was in readiness to make the repairs, and the current was then turned off the line in question. The telephone operator testified that the message which was transmitted to the power house was that the current should be shut off in 10 minutes. According to her testimony nothing was said to or by her as to the length of time the current should be kept off. The operator had difficulty in making the man at the power house understand. The engineer at the power house testified that the message as understood by him was that the current should be shut off "for" 10 minutes; that his custom was to keep it off 5 minutes longer than requested; that he did so in this instance, and after 15 minutes turned on the current. When the current was again turned on the lineman was still at work and was killed by the shock. The plaintiff claimed that the defendant was negligent in not promulgating a rule to the effect that when one of its employees was engaged in repairing its lines that the current should not be again turned on until the engineer in charge of the power house had received notice that the employee had completed his work and left the line and was out of danger. It was held that the defendant company was not guilty of negligence in failing to adopt and enforce this rule, as it would merely amount to a rule that one employee should not do an act which would necessarily result in injury to another employee, and negligence cannot be predicated upon a failure to adopt such a rule. Van Alstine v. Standard Light, Heat & Power Company, of Unadilla, New York, New York Supreme Court, App. Div. 3d Dept., 112 N. Y. Supp. 416.

ELECTRIC COMPANY LIABLE FOR FURNISHING DANGEROUS APPLIANCE TO EMPLOYEE.—An action was brought against a telephone company on the following facts. The plaintiff was an experienced lineman in the employ of the defendant company. The company wished to have certain measurements made between its wires and high-tension wires of other companies where they crossed one another. To make these measurements the company sent out from its office an engineer named Phillips, and the plaintiff was instructed to go along with Phillips and to act as his assistant. Phillips brought with him from the office of the company a tape measure, which to all appearances was an ordinary linen tape. Concealed on the inside of this tape were a number of small copper wires extending through its entire length. The plaintiff, not being aware of the metal used in the construction of the tape, was directed by Phillips to ascend a pole and take the measure with him. There were two cross arms on the pole and, after the distance between the lower arm and the ground had been measured, the plaintiff was told to measure the distance between the two arms. While the plaintiff was in the act of climbing to the second arm Phillips gave the tape a twist to straighten it out and, in so doing brought it in contact with a high-tension wire carrying 23,000 volts, giving the plaintiff a shock severe enough to cause him to fall to the ground. The company claimed that the plaintiff must have come in bodily contact with the wire on the theory that 23,000 volts would have consumed the tape, and the tape was found intact after the accident. The court held, however, that the reasoning was faulty for the reason that it left out the fact that the tape had conducting capacity sufficient to carry enough electricity to shock the plaintiff without burning the wires within it and without carrying anything like the entire current flowing the high-tension wire. It was held that the proximate cause of the injury was the act of the company in furnishing the tape containing copper wires and the company was held liable in damages. Murphy v. Hudson River Telephone Co., New York Supreme Court, 112 N. Y. Supp. 149.

Obituary.

MR. A. V. SCHROEDER, general manager of the Winona Railway & Light Company, Winona, Minn., died there on Nov. 16 from an attack of typhoid fever. Mr. Schroeder before taking the management of the Winona property was electrical engineer for the Illinois Traction System, and previously to that was superintendent of the electric lighting department of the Springfield (Ill.) Light, Heat & Power Company. He helped organize the Minnesota Electrical Association last year. His loss will be felt keenly by the numerous central station men in Illinois and Minnesota, who knew his kindliness of heart and manner and his ability to accomplish important results unassumingly. It is rare that a tribute such as that given Mr. Schroeder in a recent issue of the Winona *Independent* is paid any public service company official after such a short residence in a community. As the paper puts it, "He accomplished without any display of superhuman energy what others might try in vain to bring about, simply by being friendly, obliging and on the square."

MR. JAMES E. MURDOCK dropped dead of heart failure at his home in Lafayette, Ind., Nov. 27, aged 71 years. Mr. Murdock was the head of the Murdock Syndicate, which owns and controls one of the largest systems of interurban lines in the State. He was born in Ireland in 1837 and came to Indiana when a mere lad, where he obtained a limited education by attending night school. His executive ability was demonstrated while in the contracting business building roads, bridges and public buildings. Mr. Murdock was the head of the Indiana and Ohio syndicate, controlling millions of dollars invested in natural gas plants, and when gas failed was quick to see the necessity of installing large gas plants to utilize the pipe lines in the distribution of artificial gas. In early days he owned a number of street car lines in the State and lost no time in converting them into electric lines. He and his sons next made investments in interurban railway property and the Murdock estate is now the largest owner of street and interurban railways in Indiana. In addition, Mr. Murdock owned and operated several electric light plants in Indiana and Ohio. Mr. Murdock was public spirited, a very popular man and enjoyed a wide acquaintance. Notwithstanding his vast wealth, he always remained democratic in his way.

Personal.

PROF. H. T. PLUMB, of Purdue University, delivered a lecture Nov. 27 in the electrical building of Purdue before the Indiana Academy of Science on the subject of high frequency currents.

MR. B. H. BENDHEIM has been made manager of the New Orleans office of F. E. Newbery & Co., electrical engineers and contractors, and will have charge of all work in the Southern States.

MR. THOMAS G. HANSEN, superintendent of transportation of the Manila Electric Railway & Light Company, has arrived in the United States on a vacation, which he will spend in Cleveland.

MR. LOUIS J. HAUCK has been elected president of the Cincinnati Gas Light and Electric Company in the place of Mr. C. B. Taft, resigned. Mr. Taft is the brother of Hon W. H. Taft, President-elect.

MR. LORAN L. LEWIS, JR., of Buffalo, N. Y., has been elected president of the Buffalo, Batavia & Rochester Electric Railway Company, of Batavia, N. Y., to succeed Mr. George L. Lewis, his brother, who has resigned and taken up his residence in New York City.

MME. CURIE, who was associated with her husband, the late Prof. Curie, in the discovery of radium, and succeeded him in the professorship held by him in the Faculty of Sciences, in the University of Paris, has now been appointed chief professor of physics in that faculty.

DR. S. W. STRATTON, director of the Bureau of Standards, Washington, D. C., will deliver the Founders' Day address, on Dec. 1, on the occasion of the 12th anniversary of the Thomas S. Clarkson Memorial School of Technology, Potsdam, N. Y., in the assembly hall at 8 p. m.

MR. FREDERICK LAKE, electrical engineer in charge of the transformer house of the Niagara, St. Catherines & Toronto Railway Company at Niagara Falls, Ont., has severed his connection with the railway company to accept a similar position with the Cataract Power Company at Niagara Falls.

MR. C. HUDSON, chief of the Sacramento power division of the Pacific Gas & Electric Company, with headquarters in Sacramento, Cal., has accepted the position of chief of the hydro-electric transmission department of the Great Western Power Company. He will still be located in Sacramento, Cal.

MR. EDWARD SCHILDHAUER, electrical and mechanical engineer of the Isthmian Canal Commission, formerly with the Chicago Edison Company, and Mrs. Schildhauer have returned to the Isthmus from Europe, where Mr. Schildhauer has been investigating the mechanism of locks on canals in Great Britain, Germany, the Netherlands and Belgium.

MR. GEORGE WILLIAMS, of H. L. Doherty & Company, New York, delivered an address recently before the Merchants' Association of Worcester, Mass., at its annual meeting upon the advantages of the liberal use of electric lights in a city. The business men of Worcester are greatly interested in promoting both public and private illumination.

MR. GRANT W. SPEAR, vice-president of the Dearborn Drug & Chemical Company, Chicago, Ill., who was formerly located at the home office, has taken charge of the New York office of the company and will hereafter act as Eastern manager. Mr. W. B. McVicker, formerly manager of the Eastern office, has severed his connection with the company.

MR. MELDON H. MERRILL, who, as salesman for the Westinghouse Electric & Manufacturing Company, has been active for some years past in promoting the introduction of electric drive among the textile mills in New England, has resigned his position with that company and taken up similar work in connection with the Boston office of Allis-Chalmers Company.

MR. J. W. PUTNAM has resigned his position as assistant engineer of the Toronto & Niagara Power Company. Before leaving Canada he received from the employees of the transmission line a pair of field glasses, while the employées of the Toronto terminal station marked their appreciation of his worth by giving him a gold watch fob. Mr. Putnam has moved back to this country and taken a house at 20 Davis Avenue, East Orange, N. J.

MR. D. M. COGHLAN, who has been business manager of the Canton (Ohio) Electric Company, has been made business manager of the Easton (Pa.) Gas & Electric Company, where an aggressive campaign for business will be made. Mr. B. F. Cresson remains as general manager of the Easton company. Both properties are now controlled by H. L. Doherty & Company, of New York. The Easton company has made a contract to furnish the power for the street railway system.

REED-WILD.—The wedding is announced, on Nov. 9, of Miss Eleanor Pierce Wild, daughter of Mr. and Mrs. James R. Wild, of Canton, Mass., to Mr. Franklin Holmes Reed, editor of *Telephony*. For some time Mr. Reed was editor of the *American Telephone Journal*, recently consolidated with *Telephony* and other journals of that class, and he has already made a place for himself as a technical journalist of marked ability. Prior to engaging in literary work and after graduation Mr. Reed had considerable experience as a telephone engineer.

Trade Publications.

THERMIT WELDING is thoroughly treated in an instructive manner in a quarterly published by the Goldschmidt Thermit Company, 90 West Street, New York.

NERNST LAMPS are discussed in a convincing manner in a publication designated as Vol. VI, No. 5, of the "Glower" issued by the Nernst Lamp Company, Pittsburg, Pa.

ELECTRIC HEATERS, including toasters, foot warmers and curling tongs, are fully discussed in a publication issued by the Pacific Electric Heating Company, Ontario, Cal.

BUSHING.—The Steel City Electric Company, 1207 Washington Ave., North Side, Pittsburgh, Pa., has issued an attractive folding mailing card dealing with the "Star" bushings.

H. KRANTZ MANUFACTURING COMPANY, of Brooklyn, has issued recently Bulletin No. 22, devoted to its punched clip knife switches, giving an engraving and full details as to sizes, prices, etc.

MOTOR STARTERS AND CONTROLLERS.—The J. L. Schureman Company, Chicago, Ill., has issued a bulletin describing the company's new line of alternating-current self-starters and electric elevator controllers.

MANILA ROPE.—The C. W. Hunt Company, West New Brighton, Staten Island, has issued a neat pamphlet, envelope size, as to its "Stevedore" manila rope for the transmission of power, pile driving, hoisting, etc.

HOLIDAY NOVELTIES.—The Metropolitan Electrical Supply Company, Chicago, Ill., has issued a special catalogue describing the electrical toys and novelties which the company is carrying in stock for the holiday trade.

HOLOPHANE.—The November issue of "Holophane Illumination" contains a variety of interesting data and information. Especially striking is the articles relative to the subject of factory lighting with Holophane-D'Olier metal reflectors, in which some admirable views are shown.

EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has issued three bulletins recently as to its bipolar enclosed motors, its single-phase induction motors and its electric exhaust fans. The bulletins are Nos. 3136, 3215 and 3505, and give fully illustrated descriptions of this standard apparatus.

CLEVELAND TWIST DRILL CO., Cleveland, Ohio, has just issued Catalog No. 36, devoted to its latest types of drills, reamers, sockets, mills, counter bores, mandrels, arbors and high-speed tools. These are freely illustrated and details are given as to each with prices. There is also some descriptive matter.

WIRE INSPECTION BUREAU.—The Wire Inspection Bureau, Engineering Societies Building, New York City, through Mr. Hugh T. Wreaks, secretary, has just issued for November its "Handbook" bearing on insulated wire and cable tests and the methods adopted, etc. Facsimiles are shown of the test stamps used by the bureau.

SEWING MACHINE MOTORS.—The Diehl Manufacturing Company, Elizabethport, N. J., has recently issued Bulletin No. 56, devoted to its sewing machine motors, for operation on direct-current circuits. The Diehl motor and "transmitter" are well known as an effective combination and these are clearly shown and described.

INDUCTION MOTORS.—The Western Electric Company has just issued a booklet, envelope size, which takes up the subject of machine drive by induction motors quite comprehensively, and shows Western Electric motors of this type attached to various kinds of machinery, light and heavy. There is also some simple explanatory text.

MAKING PITTSBURG TRANSFORMERS.—The Pittsburg Transformer Company has issued an interesting pamphlet entitled "Making Pittsburg Transformers." With the camera an illustrated record of each step in the manufacture of a Pittsburg transformer has been reproduced, and every detail of the transformer is carefully explained.

GRAPHITE AND GREASE.—This is the title of a little folder of eight pages issued by the International Acheson Graphite Company, of Niagara Falls, N. Y. It deals with the company's lubricant composed of graphite and grease made up in various combinations for specific and general uses. Of these very full and interesting details are given.

VALVES.—The American Steam Gauge & Valve Manufacturing Company, of Camden Street, Boston, Mass., has just issued a handsome and comprehensive catalogue of 89 pages, embracing details as to its various types and forms of valves and parts. All these are fully and clearly illustrated, and a great variety of useful data is given as to each specialty or standard article.

COMMUTATOR TRUING.—Jordon Bros., Inc., 74 Beekman Street, New York, have just issued a neat illustrated pamphlet with regard to their well-known and useful commutator truing device. It is shown and described in all its details and in various forms of applications to dynamo electric machinery. There is also a long list of users and a number of excellent testimonials.

PIPE TAPLETS is the theme of the November "Paistery" issued by H. T. Paiste Company, of Philadelphia. These are a new line of conduit fittings. The taplet is attached to the conduit by pipe threads located inside the sleeve, with a set screw style of adjustment. These are shown for three sizes of pipe or conduit and in the several styles. Switch fittings for pipe taplet work are also shown.

VARIOUS PUMPS.—The Geo. F. Blake Mfg. Co., 115 Broadway, and the Knowles Steam Pump Works, same address, have just issued a series of bulletins devoted to the various forms and styles of their Blake and Knowles pumps—boiler feed and tank, single and duplex; single horizontal piston pumps and sinking pumps. These are illustrated and contain numerous tables as to sizes and capacities.

ELECTRIC GOODS MFG. CO., 115 Purchase Street, Boston, Mass., has issued three handsome and useful catalogs in various sizes as to its Samson battery and its telephones. The literature is excellent for its purpose. The large telephone pamphlet is virtually a section of its nineteenth edition catalog and is remarkably full and complete, occupying nearly 70 pages, profuse in detail, illustrations, prices, etc.

REMOTE CONTROL SWITCHES.—The Central Electric Company, of Chicago, is distributing an illustrated 15-page circular describing its new P-M remote control switches. The circular contains cuts showing not only the construction of the switch, but also its application for the wiring of theaters, churches, residences, etc. A pressure gage is also illustrated, to be used in conjunction with the switch for the control of motors, operating pumps, etc.

VICTOR FLAMING ARC LAMPS.—The Western Electric Company is sending out a bulletin on its Victor flaming arc lamps. As these lamps

are an especially active feature at present in illumination, the information contained in this bulletin is especially interesting. It is claimed that one of the special features of this lamp is the absence of any regulating mechanism for controlling the carbons, this being accomplished by gravity as they are burned away.

EMPIRE MINIATURE LAMPS.—The Pettingell-Andrews Company, Pearl Street, Boston, Mass., has issued an extremely tasteful and attractive booklet, devoted to its Empire miniature lamps, sockets, receptacles, etc. It has a handsome embossed cover in cream tints, which are also used throughout the booklet, the lamps all being shown full size. The pamphlet is 48 pages, small quarto, and is very timely for this season of the year, when decorations are so much in vogue.

CABLE MANUFACTURE.—An interesting little pamphlet has been issued by the Western Electric Company, illustrative and descriptive of its plant at Hawthorne, Ill., for the manufacture of its cable, of which vast quantities are used in the telephone industry, as well as in other fields. The processes are shown in the various departments through to the finished product. There is also, by way of contrast, a view of prostrated lines torn down from poles by wintry ice and gales—disaster that the use of cable would have avoided.

CURVE-DRAWING INSTRUMENTS.—Bulletin No. 4627, issued recently by the General Electric Company, Schenectady, N. Y., contains matter descriptive of the company's curve drawing instruments for alternating and direct-current circuits. These instruments, in commercial use for several years, have been recently improved by the General Electric Company and the illustrations and descriptions contained in the bulletin will be found to be of special interest. The bulletin contains also connections, dimension diagrams and prices of the newer types.

"JUICE" is the terse title of the new monthly house organ the first number of which is issued for December by the Pettingell-Andrews Company, of Pearl Street, Boston. It will be devoted to its new apparatus and supplies for electric light, power and traction purposes. The cover has the title in strong letters in purple ink, with a very effective display of lighting below. Among the contents is an interesting article by Mr. G. E. Palmer on theft of current, followed by devices to prevent such losses. There is a page in the book reserved for questions.

CRESCENT SPECIALTIES.—The Crescent Company, Chicago, Ill., is sending out a 16-page catalog having for its subject the Crescent specialties, each one of which is illustrated and its salient features detailed. The specialties include the Pratt outlet boxes and covers, Harter clusters, Crescent toggle bolts, Star soldering sticks, Crescent soldering salts, compounds, wall guards, coloring fluids and lamp frosting, Innovate cord adjusters and several types of lamp guards. A page is devoted to a description of the Bates bulb cleaning and bulb removing appaartus.

DECORATIVE LIGHTING OUTFITS.—The General Electric Company, Schenectady, N. Y., is issuing a folder descriptive of its decorative lighting outfits. The use of these outfits is bound to increase so long as lights are used in connection with Christmas greenery because of the ease with which they can be installed, and, above all ,the safety with which they can be used. General Electric outfits are made in sizes containing from 8 to 32 lamps and may be connected to any socket by means of the standard attaching plug. A full description and prices are contained in Folder No. 3710.

BLOCK COVERS.—The Central Electric Company, Chicago, is distributing a 15-page circular describing its O. K. fuse block covers and meter connection blocks. The booklet not only gives full description of the various devices, but by means of some 36 diagrams illustrates fully the various methods of connecting and testing house meters without interruption on the service. The booklet is entitled "Theft of Current," and it is claimed that the use of these connection blocks will effect a very considerable decrease in the unaccounted current at central stations. Copy of this booklet will be sent upon request.

"SEPARATOR TALKS" is the title of a 20-page booklet distributed by the Harrison Safety Boiler Works, 3159 North Seventeenth Street, Philadelphia, Pa., and devoted to the explanation of the first principles of separating water or oil from steam or gases. A study is made of the various devices for taking water out of live steam, purifying exhaust steam from cylinder oil (non-condensing and condensing systems), removing oil, grit and moisture from ammonia currents and compressed air, etc. The general scope of the discussion may be inferred from the chapter headings as follows: "Successful Oil Separation," "Proof of Efficiency," "Emulsion Stream," "Single vs. Multiple Baffle," "About Centrifugal Force," "About Back Pressure," "Under, Over or Around the Baffle," "Designing a Complete Separator," "Where to Use Receiver Separators," "Where to Use Oil Separators," "How to Remove Oil from Condensed Steam." Each of these chapters is really a reprint of a little esasy on the subject, previously published in one of the technical magazines. In addition, the booklet contains drawings and tables of dimension sof the Cochrane steam and oil separators manufactured by this concern.

Business Notes.

THE CUTLER-HAMMER MFG. CO., of Milwaukee, Wis., is planning to make large additions to its works, the cost of which is estimated at $75,000.

MR. GEORGE W. ARMSTRONG, manager for the Western branch of the Excello Arc Lamp Company, has started on an extensive trip through the South, which will be extended to Southern California.

THE CHARLES L. KIEWERT COMPANY, Milwaukee, which for some time has had the agency for Siemen's carbons, has been appointed American agent for the Siemens-Schuckert flaming arc and "Alba" lamps.

MATHIAS KLEIN & SONS, Chicago, Ill., manufacturers of linemen's tools and line construction materials, reports that there is a noticeable renewal of activity in line construction work throughout the Western States.

THE VULCAN ELECTRIC HEATING COMPANY, Chicago, Ill., is making large deliveries on the order received a few weeks ago for Del curling irons. The original order was for 72,000 irons and was placed by the Del-Sales Company, of Chicago.

THE BELDEN MANUFACTURING COMPANY, Chicago, Ill., announces that it has added to its stock of 18 to 30 per cent German silver resistance wires, three types of imported wires, known as 1A 1A, for electrical instruments, and Superior and Krupp wires, which are made especially for heating purposes.

THE CRESCENT COMPANY, Chicago, Ill., reports that the "Baby Torch," a tool-kit necessity for electricians, carpenters, machinists and engineers, as well as for men engaged in all kinds of repair work, is meeting with ready sales throughout the United States. The "Baby Torch" was recently purchased by the Crescent Company from the Zeigler Lamp & Brass Company.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has appointed John Mustard as assistant manager of sales for the East, including Pittsburgh and territory east of that point. The headquarters of Mr. Mustard will be in Philadelphia. He has been with the Wagner Electric Manufacturing Company as district manager for Philadelphia for the past 15 years.

THE WARD LEONARD ELECTRIC CO., of Bronxville, N. Y., announces that it can mount any size resistance unit shown in its catalog, G 1, in the same manner that its B size has been mounted in the past; that is, with a screw base attachment suitable for mounting in an Edison lamp socket. Increasing orders for this 50-watt unit from telephone and telegraph companies have induced this company to reach out into other lines for this class of trade.

LARGE VALVE ORDER.—The Lunkenheimer Company, Cincinnati, has received from the Isthmian Canal Commission an order for no less than 7000 bronze globe and angle valves, in sizes ranging from ¼ in. to 3 in., inclusive. The "Renewo" renewable seat and disk regrinding valve covered by the order is practically indestructible, as every part that is subjected to any possible wear can be easily, quickly and cheaply renewed. The valves are guaranteed for 20-lb. working pressure.

MR. C. M. GARRISON, who was with the Empire Wire Company, is re-establishing his business as a worker and dealer in copper, copper wire in bare and insulated forms, sheet and specialties, i. e., oxide, sulphate, etc. His office is at No. 100 William street, New York. He has a wide acquaintance with the trade. Before going with the Empire Company he handled as much as 15,000,000 pounds of the red metal in a year, and he expects equally large orders from many old customers now.

MR. L. G. BASSETT, formerly senior salesman of the Buffalo district office, Westinghouse Electric & Manufacturing Company, has resigned his position to become associated with McCarthy Bros. & Ford, of Buffalo, who have executed a contract with the Western Electric Company by which they become special agents for power apparatus for all western New York. Mr. Bassett will give his attention to the sale of Western Electric apparatus throughout this territory and particularly in districts supplied with Niagara Falls power.

MR. G. KEARSLEY SELDEN is now located in Atlanta, Ga., where he holds the important position of plant supervisor of the entire plant of the Southern Bell Telephone & Telegraph Company. Until recently he has been with the Bell interests in Washington, D. C., having resigned the position of construction engineer for the Washington division of the Chesapeake & Potomac Telephone Company to accept the offer from Atlanta. Mr. H. P. Stabler has been appointed to fill the vacancy in the Chesapeake & Potomac Telephone Company caused by this change.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., will take a very active part in the Alaska-Yukon-Pacific Exposition, which will be held at Seattle, opening June 1. It has engaged a large space, 40x17 ft., on the main aisle of the Manufacturers' Building, where it will display its complete line of apparatus and material. A switchboard will be operated from their booth, giving telephone service to all the exhibitors' spaces on the grounds, and general toll line service to all outside points, through the Independent Telephone Company, which uses Stromberg-Carlson apparatus.

THE GENERAL INCANDESCENT LAMP CO. has moved its general office from the factory at 1811 East Forty-fifth Street, Cleveland, O., to suite 202-208 Electric Building, that city. Larger quarters were necessary in order to handle the greatly increased volume of business which this company has secured since the introduction of the G. I. tungsten lamp. It is the hope with the larger and better facilities now afforded to give even prompter service in the future than in the past. The General Incandescent Lamp Co. is one of the oldest concerns of the kind in the United States. It manufactures a full line of carbon, "Gem" and high efficiency lamps, including miniature and low voltage lamps, both tantalum and tungsten, for all voltages and conditions. It also has a special department where any special type of lamp can be manufactured at any time and this class of business is solicited.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

American Association of Electric Motor Manufacturers. Secretary, W. H. Tapley, 29 West 39th St., New York.

American Electro-Therapeutic Association. Secretary, Dr. Albert C. Geyser, Willis Ave., New York City.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, United Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

Association of Iron and Steel Electrical Engineers. Secretary, G. H. Winslow, 559 Frick Building Annex, Pittsburg, Pa. Next meeting, October, 1908.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Room 511 Harvester Building, Chicago. Next meeting, Detroit, June 23, 24 and 25, 1909.

American Street & Interurban Railway Engineering Association. Secretary, Walter S. Mower, London, Ont.

American Society of Mechanical Engineers. Secretary, Calvin W. Rice, United Engineering Societies Building, 29 West 39th St., New York.

American Society of Municipal Improvements. Secretary, A. Prescott Folwell, Room 512 Flatiron Building, New York.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York.

Association of Car Lighting Engineers. Secretary, G. B. Colegrove, Chicago & Illinois Railroad, Electrical Department, Chicago.

Association of Edison Illuminating Companies. Secretary, S. E. Mumford, Detroit, Mich.

Association of Electric Lighting Engineers of New England. Secretary, W. H. Cole, Waltham, Mass. Annual meetings held in Boston, third Wednesday in March.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St., W., Toronto, Ont.

Central Electric Railway Association. Secretary, A. L. Neereamer, Indianapolis, Ind.

Chicago Electric Club. Secretary, S. M. McFedries, care J. L. Schureman & Co., Chicago.

Cleveland Engineering Society. Secretary, J. C. Beardsley, 718 Caxton Building, Cleveland, Ohio.

Colorado Electric Light, Power & Railway Association. Secretary, J. C. Lawler, Colorado Springs, Col.

Electrical Contractors' Association of New York State. Secretary, Geo. W. Russell, Jr., 500 Fifth Ave., New York.

Electrical Contractors' Association of State of Missouri. Secretary, Charles J. Sutter, 1220 Pine St., St. Louis, Mo.

Electrical Salesmen's Association. Secretary, Francis Raymond, 209 State St., Room 1002, Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of Chicago. Secretary, Frederick P. Vose, Marquette Building, Chicago.

Electrical Trades Association of Philadelphia. Secretary, E. A. Symmes, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Friday of each month.

Empire State Gas & Electric Association. Secretary, Charles H. B. Chapin, 154 Nassau St., New York.

Illinois State Electric Association. Secretary, H. E. Chubbuck, Ottawa, Ill.

Illuminating Engineering Society. Secretary, V. R. Lansingh, 33 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

Independent Electrical Contractors' Association of Greater New York. Secretary, Lewis H. Woods, Imperial Hotel, Broadway and 32d St., New York.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., 1909.

International Independent Telephone Association. Secretary, J. B. Ware, Grand Rapids, Mich.

Iowa Electrical Association. Secretary, W. N. Keiser, Des Moines, Ia. Next meeting, Cedar Rapids, Ia., April 21 and 22, 1909.

Iowa Independent Telephone Association. Secretary, C. C. Deering, Boone, Ia.

Iowa Street & Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting, Cedar Rapids, Ia., April, 1909.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ky. Regular meetings, second Tuesday in October each year.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electrical Association. Secretary, A. C. Marshall, Port Huron, Mich.

Minnesota Electrical Association. Secretary-Treasurer, Ludwig Kemper, Albert Lea, Minn.

Missouri Independent Telephone Association. Secretary, G. W. Schweer, Windsor, Mo.

Missouri Electric Light, Gas & Street Railway Association. Secretary, C. L. Clary, Sikeston, Mo.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National Electric Light Association. Secretary, John F. Gilchrist, 139 Adams St., Chicago. Headquarters, 33 West 39th St., New York.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 94 Genesee St., Utica, N. Y.

National Electrical Inspectors' Association. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn.

National Electrical Trades Association. Secretary, Fred. P. Vose, 1343 Marquette Building, Chicago.

Nebraska Electrical Association. Secretary, William Bradford, Lincoln, Neb.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New York Electrical Society. Secretary, G. H. Guy, 33 West 39th St., New York.

New York State Independent Telephone Association. Secretary, R. M. Eaton, Niagara Falls, N. Y.

Northwest Electric Light & Power Association. Temporary chairman, J. D. Crary, Aberdeen, Wash. Next meeting, Seattle, 1909.

Northwestern Electrical Association. Secretary, Roger N. Kimball, Kenosha, Wis. Next meeting, Milwaukee, January, 1909.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio.

Ohio Independent Telephone Association. Secretary, Ralph Reamer, Columbus, Ohio.

Ohio Society of Mechanical, Electrical & Steam Engineers. Secretary, David Gaehr, Schofield Building, Cleveland, Ohio.

Oklahoma Electric Light, Railway & Gas Association. Secretary, Galen Crow, Guthrie.

Old Time Telegraphers' & Historical Association. Secretary, F. J. Scherrer, 195 Broadway, New York. Next meeting, Pittsburg, Pa., 1909.

Pennsylvania Electric Association. E. L. Smith, Tonawanda, Pa., secretary.

Pennsylvania State Independent Telephone Association. Secretary, H. E. Bradley, 136 South Second St., Philadelphia, Pa.

Pike's Peak Polytechnic Society. Secretary, E. A. Sawyer, Colorado Springs, Col. Meeting second Saturday of each month.

Society for the Promotion of Engineering Education. Secretary, Arthur L. Williston, Pratt Institue, Brooklyn, N. Y.

Society of Wireless Telegraph Engineers. Secretary, C. E. Russell, Boston, Mass. Monthly meetings, fourth Monday each month. Next annual meeting, fourth Monday in February, 1909.

South Dakota Independent Telephone Association. Secretary, E. R. Buck, Hudson, S. D.

Southwestern Electrical & Gas Association. Secretary, J. A. Myler, Jr., 608 Juanita Building, Dallas, Tex.

Street Railway Accountants' Association of America. Secretary, E. M. White, Box 345, Hartford, Conn.

Street Railway Association of the State of New York. Secretary, J. H. Pardee, Canandaigua, N. Y.

Vermont & New Hampshire Independent Telephone Association. Secretary, E. B. Seeley, St. Johnsbury, Vt.

Vermont Electrical Association. Secretary, A. B. Marsden, Manchester, Vt.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED NOV. 24, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

904,522. CABLE CONNECTOR; John D. Firmin, Norwood, Ohio. App. filed Aug. 20, 1906. Coupler for cables comprising two screw thread terminal members with tightening sleeves for drawing them together.

904,524. ELECTRIC LIGHTING DEVICE; Joshua T. Fisk, Rochester, N. Y. App. filed Oct. 28, 1907. Cigar lighter provided with a removable cup-shaped socket, a resistance therein, a protecting perforated cover, the socket forming an air space beneath the resistance.

904,529. ELECTRIC-FURNACE MUFFLE; John F. Hammond, Prince Bay, N. Y., and Ralph B. Savin, Philadelphia, Pa. App. filed Feb. 27, 1908. For dentist's use. A hollow, inner member is open at both ends, the outer member being longer than the inner member, and a plug is provided for closing the rear end of the inner member, and holding the same in place.

904,532. ARC-LAMP ELECTRODE; Henry Stafford Hatfield and Frank Michael Lewis, Brighton, England. Enclosed arc lamp with electrode of carbon, calcium fluorid, carborundum and carbon.

904,540. PROCESS OF ELECTRIC WELDING; Laurence S. Lachman, New York, N. Y. App. filed March 24, 1905. Welds pulleys by forming protuberances on the surfaces to be united, placing them together and passing welding current through the protuberances.

904,541. DEVICE TO PREVENT TROLLEY WHEELS FROM JUMPING; William O. Lane, Cleveland, Ohio. App. filed March 12, 1908. Has a bracket near the upper end of the trolley pole, carrying arms extending in advance of the pole and a roller in the arms.

904,550. AUTOMATIC FIRE-ALARM, BURGLAR-ALARM AND TELEPHONE SYSTEM; George F. Milliken, Boston, and Frederick W. Cole, Newton, Mass. App. filed Oct. 16, 1905. A normally closed electric current connects central with the subscriber having a telephone. A branch wire leads from the circuit to the subscriber. Circuit operating devices adapted to open the circuit, and connect it with the branch wire are provided, as well as other circuit operating devices to open the circuit only. Signaling magnets and signal receiving relays at the central station give the signals.

904,583. TELEPHONE SYSTEM; Harry G. Webster, Chicago, Ill. App. filed Feb. 28, 1903. A relay in the path of the voice currents and non-inductive resistance adapted to be connected in parallel with the winding of the relay, and in the path of the talking current by the actuation of the relay, the relay being actuated by a current over the telephone line, so that the talking currents and direct current are provided with parallel paths during conversation.

904,592. ELECTRICAL CONDUCTOR SUPPORT; John Scott Allen, Los Angeles, Cal. App. filed March 22, 1906. Provides an insulator whose parts may be readily separated for handling or shipment and quickly assembled. Details.

904,603. CONNECTOR; Clarence T. Crocker, Norwood, Ohio. App. filed Aug. 31, 1906. A coupler which can be quickly and securely joined or separated, having interfitting extensions and a pair of sleeves for clamping them together.

904,640. ARC LAMP FOR STEREOPTICONS, ETC.; Herbert F. Patton, Cleveland, Ohio. App. filed May 13, 1907. Means to support two carbons in intersecting lines which are independently adjustable along such lines and oscillatory on an axis passing through the point of intersection. Keeps the luminous arc at a fixed point.

904,645. BATTERY GRID; Franklin W. Post and Archie M. Morley, Los Angeles, Cal. App. filed Aug. 21, 1906. A network of cells consisting of ribs in different plans. The ribs of one set extend across the spaces of the other set.

904,661. CIRCUIT-CLOSING RELAY; Jean F. Webb, Jr., Denver, Col. App. filed May 12, 1908. A relay which rotates a shaft which carries an insulating block, having a portion engaging the armature of the relay to lock it in its circuit-closing position.

904,663. MANUFACTURE OF RAIL BONDS; Walter Howard Williams, Mansfield, Ohio. App. filed Nov. 14, 1906. A process of making rail bonds consisting in forming a stranded terminal member with the strands separated to form an aperture. Then inserting one end of a body portion into the aperture and compressing the joint.

904,677. ELECTRIC-CURRENT BATHING TUB; Friedrich Braun, Dresden, Germany. App. filed Dec. 4, 1907. A bath tub for medical use with electrodes in it, and a partition across the tub to support the knees of the bather with his feet in one compartment and his body in another.

904,684. METHOD OF ELIMINATING COPPER FROM COAGULATED CELLULOSE; Emile Crumiere, Paris, France. App. filed Feb. 19, 1908. Process of freeing cellulose from copper by passing an electric current through a solvent of the cellulose.

904,693. SYNCHRONOUS SPEED INDICATOR; Arthur Eugene Griffin, Winthrop, Mass. App. filed March 13, 1905. An induction motor, a source of alternating current therefor, a source of direct current and a speed indicator responsive to alternating current and a converter for the direct current, likewise influencing said indicator.

904,728. ELECTRIC-LAMP RECEPTACLE FOR ELECTRIC SIGNS; Frederick W. Ruby, Jackson, Mich. App. filed March 20, 1908. A porcelain socket with a receptacle therefor consisting of two nesting screw sleeves of soft metal, so that the expansion and contraction will have no serious effect on the socket.

904,741. ELECTRICALLY OPERATED SEMAPHORE MECHANISM; Jean F. Webb, Jr., Denver, Col. App. filed May 12, 1908. An electric motor turns the semaphore shaft, and means are provided for disconnecting the motor from the shaft and for holding it in its signalling position.

904,743. ELECTRICAL PRINTING APPARATUS; Milton T. Weston, Orange, N. J. App. filed Sept. 25, 1901. A distributor and selecting device for a printing telegraph having a plurality of electromagnetically controlled trip devices, a continuously moving carrier on which said devices are mounted, and printing means controlled by the trip devices.

904,765. SYSTEM OF CONTROL FOR ELECTRIC MOTORS; Arthur C. Eastwood, Cleveland, Ohio. App. filed May 9, 1908. Means for limiting the flow of current supplied to a motor consisting of a resistance in series with the main motor circuit, a manual controller therefor, a second resistance in series with said circuit and means for automatically short-circuiting said second resistance, said latter means being operative only when all of the first resistance is cut out by the manual controller.

904,768. TELEGRAPH SYSTEM; Stephen D. Field, Stockbridge, Mass. App. filed Dec. 1, 1906. Increases speed of signals on long lines by impressing a counter-electro motive force on the line, counter to line current when circuit is opened to form signals.

904,771. ELECTRIC WELDING MACHINE; Weston M. Fulton, Knoxville, Tenn. App. filed Feb. 7, 1906. For welding seams of tubular sheet metal bodies. Provides a plurality of electrodes between which the work to be welded passes, a work supporting carriage and electric switch, and means on the carriage to actuate the switch to close the circuit as the work enters between the electrodes, and to open the circuit as the work leaves the electrodes.

904,776. SYSTEM OF ELECTRIC DISTRIBUTION; Caryl D. Haskins, Schenectady, N. Y. App. filed Sept. 26, 1904. A motor meter, which automatically interrupts a heating circuit so as to make it unfit for lighting, and thus prevents fraudulent use of the heating circuit for lighting purposes.

904,780. SYSTEM OF CONTROL; George H. Hill, Schenectady, N. Y. App. filed March 23, 1907. Electric railway controller for direct current in city limits and alternating current in the country, having a translating device, a main controller having separate alternating-current and direct-current governing means for said device and a master controller for the main controller.

904,782. ROTARY CONVERTER FOR ELECTRIC WELDING; Arthur M. Hoffman, Johnstown, Pa. App. filed Dec. 23, 1907. Converts direct into alternating currents for electric rail welding. The converter comprises a rotor, together with a series of resistances which are cut in and out of the circuit during each cycle.

904,783. INDICATING AND RECORDING INSTRUMENT; William F. Howe, Schenectady, N. Y. App. filed Sept. 17, 1907. A meter having field coils and a rotatable armature, together with a member movable in response to variations in the field, a controlling spring and a pointer.

904,786. CIRCUIT CLOSER FOR FIRE-ALARM CIRCUITS; William Wesley Katterjohn, Henderson, Ky. App. filed May 20, 1908. A flexible cord is attached to the wall of the room. When it burns it operates a particular form of circuit closer.

904,788. AUTOMATIC CARRIER SYSTEM; Sam H. Libby, East Orange, N. J. App. filed March 12, 1906. A carrier is loaded and then moved to a dumping station, then returned to the loading station, by means of an electrical circuit, a resistance normally in the circuit, a carrier receiving current from the circuit and means automatically controlled by the carrier for eliminating the resistance.

904,789. AUTOMATIC CARRIER SYSTEM; Sam. H. Libby, East Orange, N. J. App. filed March 12, 1906. A travelling carrier system, comprising a loading and unloading station, a supply conductor with a dead section at the unloading station, a carrier having a pair of current collectors engaging the conductors and driving motor on the carrier, a reversing switch and means for operating the switch at the unloading station.

904,794. GENERATION, CONTROL AND TRANSMISSION OF ELECTRIC ENERGY, PARTICULARLY FOR USE ON AUTOMOBILES AND LIKE VEHICLES; Albert Henry Midgley, London, England. App. filed Feb. 26, 1908. A prime mover and dynamo connected thereto, and having two armatures, and two field coils with means for moving the field coils axially with relation to the armatures and an electric motor receiving current from the dynamo.

904,801. CURRENT-COLLECTING APPARATUS FOR DYNAMO-ELECTRIC MACHINES; Jakob E. Noeggerath, Schenectady, N. Y. App. filed Oct. 10, 1906. A brush for dynamos, so that the portion which takes the wear carries little current, while the portion through which the current flows is subjected to little wear. The brush is built up of strips or laminations of suitable material to accomplish this result.

904,808. INSULATING MATERIAL; George H. Rupley, Schenectady, N. Y. App. filed Aug. 7, 1907. An insulating material comprising a fabric impregnated with a soft pliable non-adhesive material and coated with linseed oil varnish.

904,810. DISTANCE-CONTROL APPARATUS FOR TRANSLATING DEVICES; Ernest Schattner, London, England. App. filed Aug. 6, 1906. An electric circuit with means for controlling the operation of translating devices therein comprising a plurality of reeds tuned to different vibration rates, an electromagnet operating the reeds and a generator for impressing on the circuit rates of electric vibration corresponding to the rates of the reeds.

904,826. LAMP REDUCER; Charles Wirt, Philadelphia, Pa. App. filed March 18, 1907. Lamp dimmer, having a socket for attachment to a lamp, a plug for attachment to the socket and a rotary rheostat ring surrounding the socket.

904,831. PROCESS OF MAKING HOMOGENEOUS BODIES FROM TANTALUM METAL OR OTHER REFRACTORY METALS; Werner Von Bolton, Charlottenburg, Germany. App. filed Jan. 5, 1904. Compresses a quantity of tantalum powder, fuses the same by an electric current in an inert atmosphere.

904,832. ELECTRICAL FUSE PLUG; Harold E. Bradley, Greenwood, R. I. App. filed Jan. 3, 1908. A casing receives the fuse, a cap engages one end of the casing and means are provided for locking the cap to the casing.

904,834. ELECTRIC RAILWAY SIGNALING SYSTEM; Yorke Burgess, Washington, D. C. App. filed Dec. 7, 1907. Details in a system of signaling with a number of signals on each train operated separately by different strengths of electric current.

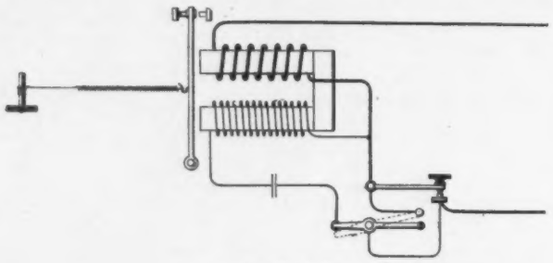
904,850. TELEPHONE SYSTEM; Francis W. Dunbar, Chicago, Ill. App. filed May 9, 1904. A polarized line signaling device connected with the telephone line operated when the subscriber is calling, a

cord circuit at the central office to establish connections with the line for conversation, a pair of electromagnets, associated with each limb of the cord circuit, a supervisory signal controlled thereby, one of the magnets in a local circuit, the current in the local circuit being in the proper direction to render the device inoperative, the other magnet being placed under the control of the subscriber, serving, when energized, to render the supervisory signal inoperative.

904,851. CONTROLLER FOR ELECTRIC DRILLS; William O. Duntley, Chicago, Ill., and Henry J. Kimman, Cleveland, Ohio. App. filed Jan. 22, 1906. A reversing switch is provided in connection with the main switch, the former being operable only when the main switch is in its "off position," so that the motor cannot be reversed while running in the opposite direction.

904,871. ELECTROMAGNET; George Washington Henry, New York, N. Y. App. filed July 31, 1907. A uniform pull is produced by providing a lever with a shiftable fulcrum, the lever having a movable connection with the armature.

904,877. TROLLEY FOR CARS; John Kaufman, Hazleton, Pa. App. filed June 5, 1908. The trolley remains in contact with the wire.



904,768—Telegraph System.

The head is of two parts hinged together on a vertical access with a contact wheel in each part. Oil is fed to the journals of the wheels.

904,881. PROCESS OF ELECTRIC WELDING; Laurence S. Lachman, New York, N. Y. App. filed May 8, 1907. A process of spot welding, which consists in perforating one of the bodies to be welded, and passing an electric current through the bodies in the region surrounding the perforation.

904,882. PROCESS OF ELECTRIC WELDING; Laurence S. Lachman, New York, N. Y. App. filed May 8, 1907. A process of spot welding sheets, which consists in overlapping them, pressing a punch of smaller area than the lapped portions against them, and passing a current through the spot.

904,887. VOLTAGE REGULATOR FOR DYNAMO-ELECTRIC MACHINES; George S. Neeley, St. Louis, Mo. App. filed Nov. 30, 1906. Regulates voltage for alternating-current generators by regulating the field of the exciter for the generator in response to a differential electromotive force resulting from placing the field current of the exciter in opposition to the current output of the generator.

904,889. ALARM DEVICE FOR FIRE-ALARM BOXES; Joshua B. Nicholson and Artemus R. Warfield, Washington, D. C. App. filed June 30, 1908. Notifies the neighborhood when a false alarm is sent off, by ringing a bell at the box, thus detecting the party sending out the alarm.

904,892. STREAM-POWER ELECTRIC FLOAT; William J. Pattosien, San Rafael, Cal. App. filed Dec. 17, 1907. A dynamo with both field and armature revoluble, two undershot water wheels, a connection from one wheel to the field magnets and a connection from the other wheel to the armature.

904,894. DAMPER REGULATOR; William Roberts and Dellford H. Holloway, Waterford, N. Y. App. filed Sept. 11, 1907. Controls the damper by steam pressure, which actuates a Bourdon tube that, in turn, controls an electric contact.

904,897. ROTARY SWITCH; Frank J. Russell, New York, N. Y. App. filed May 13, 1907. A rotary snap switch with the plug stamped from a single blank of sheet metal, the bottom wall of the plug being slit to form bearing wings.

904,898. FLOOR-POCKET RECEPTACLE AND PLUG; Frank J. Russell, New York, N. Y. App. filed June 7, 1907. Floor pocket for theatre stages with a clean out opening, and special provision for guiding the plug contacts into place.

904,902. LINE INTERRUPTER FOR ELECTRIC RAILWAYS; Albert Thode, Hamburg, Germany. App. filed July 8, 1908. A trolley insulator provided with shoes to raise a trolley wheel or harp, as it passes under the insulator.

904,903. TELEPHONE ANNUNCIATOR AND JACK; Henry Tideman, Menominee, Mich. App. filed July 6, 1907. The armature has a journal shaft integral therewith. A threaded sleeve for the shaft is removable to permit removal of the shaft.

904,906. DRUM CONTROLLER; Henry J. Wiegand, Milwaukee, Wis. App. filed March 14, 1907. Mechanically operates a series of switches in definite sequences. Comprises a plurality of reversing switches and of resistance switches, and a single rotatable member having cams to actuate said resistance switches and a part of the reversing switches, when the member is rotated in either direction.

904,917. CONDITION-CONTROLLING DEVICE; James I. Ayer, Cambridge, Mass. App. filed Oct. 29, 1906. Maintains an oven at a desired temperature by means of a pair of contacts pivotally mounted, a circuit closer movable to engage either contact, according to the temperature, the contacts being arranged to yield to a continued movement of the circuit closer.

904,918. SIGNALING SYSTEM; Garrison Babcock, Rochester, N. Y. App. filed May 31, 1906. Fire-alarm system comprising a police signal box and break wheel mechanism in the box, telephone apparatus within the box, and means whereby the break wheel mechanism is released when the telephone receiver is removed from the hook.

904,925. SYSTEM OF ELECTRICAL DISTRIBUTION; William L. Bliss, New York, N. Y. App. filed Aug. 4, 1904. For lighting cars or trains. A system wherein the regulator which confines the voltage of the generator within certain limits does not interfere with the ability of the generator to vary its output upon variations and demands for current by the translating devices.

904,928. ATTACHMENT FOR SAFETY FUSES; William J. Boemper, Rutherford, N. J. App. filed Oct. 4, 1907. Two pivotally connected arms, each having a recess adapted to receive a part of the safety fuse, clip and thumb piece, through which pressure may be applied, and transmitted to the arms to spread the same apart.

904,933. GAS-BOX ATTACHMENT; Frederic E. Brickner, Saratoga Springs, N. Y. App. filed Dec. 6, 1907. Improvement in connectors for securing electric outlet and distributing boxes upon the gas outlet pipes of buildings.

904,936. TELEGRAPH REPEATER; Lewis B. Cecil, Santa Barbara, Cal. App. filed Feb. 25, 1908. Comprises a main line and branch relay, a repeating device in connection with each relay, a mechanical means in connection with each repeating device for locking the armature of the other relay in closed position, when the armature of the first relay is open.

904,945. WIRE BRACKET OR HOLDER AND INSULATOR; Isaac L. Edwards, Aurora, Ill. App. filed March 5, 1908. Bracket and insulator made of separable sections to clamp the wire between them. Details.

904,952. COMBINATION TROLLEY AND TELEGRAPH POLE; James Hackett, Bellaire, Ohio. App. filed Aug. 14, 1908. The trolley pole is enameled and made of stepped sections, which narrow toward the top of the pole.

904,969. LIGHTNING ROD; George R. Kress, Pittsburg, Pa. App. filed Feb. 6, 1908. Improvement in Y-connecting joint for lightning rods.

904,971. AUTOMATIC RAILWAY ALARM; Niels Lang, Vancouver, B. C., Canada. App. filed April 21, 1908. Rings an alarm in the engine cab and gives a visual indication by particular construction of track circuits and engine equipment.

904,991. PROCESS OF SMELTING METALLIC COMPOUNDS AND PRODUCING CARBIDES; Edgar F. Price, Niagara Falls, N. Y. App. filed July 14, 1904. Separately pre-heats a calcium compound and carbon, mixes the pre-heated materials and electrically heats the mixture to the required temperature.

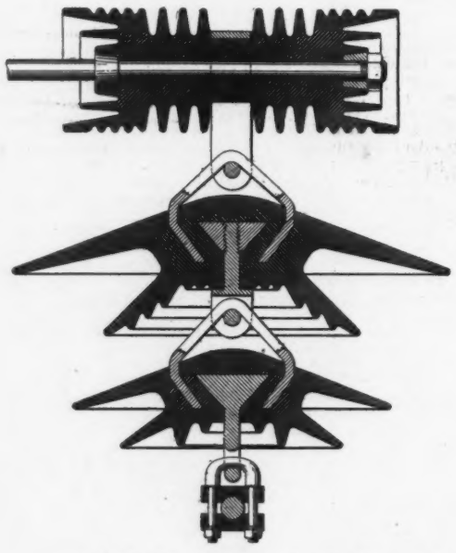
905,014. FLEXIBLE SUSPENSION FOR CONDUCTORS; Louis Steinberger, New York, N. Y. App. filed Sept. 23, 1907. For currents of high potential. A sleeve is provided at its ends with annular collars and annular air spaces between the collars for dryness.

905,045. ELECTRIC HEATING DEVICE; James I. Ayer, Cambridge, and Horace B. Gale, Natick, Mass. App. filed June 13, 1908. An electric heater with a heat-absorbing body, provided with a series of grooves and conducting ribbon secured in the grooves, which is creased longitudinally.

905,048. APPARATUS FOR THE EXTRACTION OF GOLD FROM CRUSHED ORES; Thomas Edgar Beaumont, London, England. App. filed March 29, 1906. Apparatus in which amalgamation and electro deposition are carried on simultaneously in the same vessel, together with means for circulating the ore in the vessel.

905,066. OUTLET-BOX FOR ELECTRIC WIRES; John Fountain, Jr., Elizabeth, N. J. App. filed Aug. 3, 1908. A connector is movably mounted in the wall of the box to turn angularly therein so as to receive a conductor at varying angles.

905,089. CEILING FAN; Fred. P. McBerty, Warren, Ohio. App. filed



905,014—Flexible Suspension for Conductors.

Nov. 20, 1907. An electric motor with tubular shaft, a switch above the motor in a separate casing and special means for operating the switch.

905,115. ELECTRICAL INTERRUPTER; Henry M. Sutton, Walter L. Steele and Edwin G. Steele, Dallas, Tex. Orig. App. filed Sept. 24, 1904. For electrostatic discharges. Comprises a plurality of rotatable slotted disks, with means for shifting one of the disks relative to the other, and terminals at the opposite sides of the disks.

905,119. INCANDESCENT ILLUMINANT; Orlando M. Thowless, Newark, N. J. App. filed March 8, 1899. Comprises a glower which is an insulator at ordinary temperatures and a good conductor when heated, consisting of a mixture of refractory metallic oxids, together with an electric heater for heating the glower.

905,126. PRINTING-TELEGRAPH RECEIVER; John Burry, Ridgefield Park, N. J. App. filed March 30, 1906. Improvements in printing telegraphs for army and navy use, particularly for range finders. Made to stand rough usage. Comprises a type plate carried by a lever, a plurality of fulcrums for the lever and electrical means for moving the lever on any of the fulcrums.